



DeepInsight23

EMINENT PROJECT

DEEPINSIGHT PARTNERS: UIB, ADEPTH MINERALS, AKER BP,
DEEOCEAN, SEABED SOLUTIONS, AANDERAA, NORCE, SHEARWATER

Table of Content

1	Executive Summary	3
2	Project Overview and HSEQ	4
2.1	Objectives.....	4
2.1.1	Research scope	4
2.1.2	Technological scope	4
2.2	Project Timeline	5
2.3	License.....	5
2.4	Project Partners.....	5
2.5	Company, Contractor and Subcontractors	6
2.6	Onshore Organization	6
2.6.1	Contingency Organization.....	7
2.7	Offshore Organization	8
2.8	Planning.....	9
2.8.1	Site plan	9
2.9	Procedures	11
2.9.1	Mobilization/Demobilization	11
2.9.2	Operation.....	11
2.9.3	Bio Fauna sampling.....	11
2.9.4	FlexiCore™	12
2.9.5	Instrument deployment.....	12
2.9.6	Multibeam	13
2.9.7	Video and 4K video	13
2.9.8	Pushcores.....	13
2.9.9	Rock sampling	14
2.9.10	Deployment of GridBox	14
2.10	Risk Management	14
2.10.1	HIRA (S1RA)	15
2.10.2	HAZOP (S2RA).....	15
2.10.3	RISK ASSESSMENT MATRIX & ACCEPTANCE CRITERIA.....	15
3	Mobilization.....	16
4	Operation.....	17
4.1	Operational summary	17
4.2	Platform Operations.....	20
5	Post Processing, Reporting, and results	23
5.1	Geology	23

5.1.1	Handheld XRF	23
5.1.2	Laser Induced Breakdown Spectroscopy (LIBS)	23
5.2	Geophysics	25
5.3	Microbiology	25
5.4	Macrobiology	26
5.5	Technology Test Results	26
6	Appendix Overview	27
6.1	License 851/2023	27
6.2	Sample Overview	27

DeepInsight23 – Final Report

1 Executive Summary

The DeepInsight23 expedition was performed under the “License for scientific research for natural resources on the Norwegian continental shelf - License no.: 851/2023” given by the Norwegian Petroleum Directorate to the University of Bergen - who led and owned the expedition. The Expedition was conducted between 30th of April and 30th of May.

The DeepInsight23 expedition achieved key goals in testing novel seabed coring equipment, proving the efficiency of parallel geological and biological operations, and expanding the scientific understanding of the Mohns Ridge. The expedition, mobilizing from Haugesund, Norway on April 30th, 2023, showcased commendable operational efficiency and proficiency despite setbacks due to weather conditions and mechanical issues. The mobilization phase was marked by effective coordination and execution of tasks, including the required installation of the ROV umbilical and the installation of a unique hang-off system for FlexiCore deployment below 2300m water depth. The team's ability to adapt the vessel to unique expedition requirements was evident in the successful testing phase in Sognefjord, where key equipment like the FlexiCore system and ROVs were deployed and tested. This phase demonstrated the expedition's operational capability, ensuring that all systems were verified and ready for the main phase of the expedition at Mohns Ridge.

On the Mohns Ridge, the expedition efficiently conducted site surveys and deployed the FlexiCore system at two locations, reflecting a high level of planning and execution at a previously un-visited area. Despite encountering hydraulic challenges with the FlexiCore and deeper-than-anticipated sediment at one of the sites, the team responded with prompt and effective troubleshooting and repair strategies. These responses ensured continued operation and minimal downtime. The strategic use of ROVs for environmental sampling and geological studies during repair periods further underscored the expedition's operational effectiveness. Overall, the DI23 Expedition managed to navigate operational challenges, resulting in the successful recovery of novel core and environmental data from Study Area 1. This expedition's successful operational execution contributes to the broader research and understanding of the Mohns Ridge.

2 Project Overview and HSEQ

2.1 Objectives

The main scope for the expedition was to test the Exploration Toolbox, the suite of tools for understanding seafloor minerals, for use within deep sea mineral exploration and deep-sea research. The expedition was focused on how to integrate core data and high-resolution environmental, geophysical and geological data for understanding of depositional and environmental challenges related to crustal fluid flow and deep-sea mineral exploration. The scoping points of the expedition were to:

- Test and verify techno-operational concepts for deep-sea exploration including geological, biological and environmental data collection. These concepts include wire-line coring, parallel operations with multiple subsea platforms in rugged terrain for research purposes, multistab technology, and geophysical methodology and technology for obtaining high resolution data of shallow geology.
- Obtain geological information from the subsurface of hydrothermal systems and/or Manganese crusts.
- Sample seafloor for geological and geochemical characterization of submarine fluid-flow systems.
 - Collect data to understand the fault-controlled fluid flow to study deep water-rock interaction.
- Collect marine sediments pre and post rock coring activities with an aim to define the biological baseline conditions and environmental impact of drilling activities.
- Secure insight into seafloor water-rock interactions and physicochemical parameters that drive fluid flow material transport and deposition of metals.

2.1.1 Research scope

Geological and Environmental Research

- Data collection to understand the fault-controlled fluid flow to study deep water-rock interaction.
- Obtain geological information from the subsurface of hydrothermal sulfide systems and/or Manganese crusts.
- Baseline data collection

Exploration & Environmental Toolbox

- How to improve research of the deep ocean, to map the resource base and the marine environment.
- FlexiCore Drilling
- Geophysical methods
- Environmental monitoring
- Prove that operations and methodology used for “exploration” can be performed responsibly and with limited impact.

2.1.2 Technological scope

Coring Process

- Core drilling in varied lithology (i.e., mineralized fault zones, variably altered and mineralized seafloor with overlying sediment).
- Operation in sloped terrain, and at various core drilling angles to the seafloor.
- Core sample recovery more than 50%, with a goal of 95% recovery.

- Deployable from an industry-standard offshore support (subsea) vessel or scientific research ship.

Geophysical & geochemical sensors

- Integrated, coring-concurrent geophysical data acquisition.
- Active plume monitoring for plume density and composition.
- Provide geophysical and environmental monitoring solution.

2.2 Project Timeline

The project timeline includes the following approximate milestones (Please refer to DPRs for exact timing):

January 2023 → May 2023: Preparations: Including development and interfacing, procedure development, Risk Management, Quay Side Testing, Mobilisation

May 2023 → June 2023: Operations, Demobilization

July 2023 → October 2023: PostProcessing, Analysis

October 2023 → January 2024: Reporting, ReProcessing, Analysis

2.3 License

The project was permitted by the 'License for scientific research for natural resources on the Norwegian continental shelf - License no.: 851/2023' given by the Norwegian Petroleum Directorate to UiB. The official license document can be found in Appendix under License.

2.4 Project Partners

The Deep Insight 23 expedition is a part of the Green Platform awarded project 'EMINENT' (Energy MINERals for the Net zero Transition). The EMINENT project is comprised of multiple companies coming together with the goal of creating a full value chain for deep sea minerals. The following companies, research institutes and universities are participating: Aanderaa, Adepth, Aker BP, Akvaplan Niva, DeepOcean, Future Materials (Norwegian Catapult Centre), GCE Ocean Technology, Geo Provider, Norce, NOV, Norwegian University of Science and Technology (NTNU), Seabed Solutions, Shearwater, The Arctic University of Norway (UiT) and University of Bergen (UiB).

EMINENT Project overview

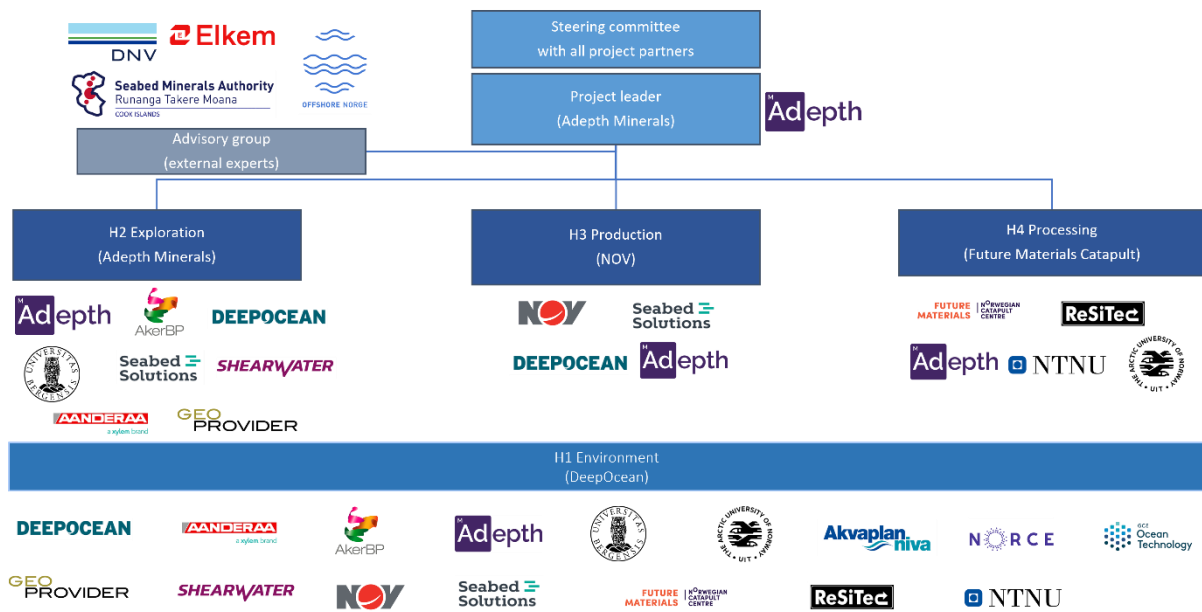


Figure 1: EMINENT project and partner overview

2.5 Company, Contractor and Subcontractors

In this document and for the DI23 operations:

UIB is the SCIENTIFIC LEAD:

Adepth Minerals is considered COMPANY

DeepOcean is considered the CONTRACTOR.

The following organizations are considered SUBCONTRACTORS:

Seabed Solutions

Anderaa

Shearwater

NORCE

2.6 Onshore Organization

An onshore organization was put together before the DeepInsight 23 expedition as a support team to the offshore organization. The team was comprised of people from the University of Bergen, Adepth and Aker BP. The chart in figure 2 illustrated the onshore organization and the relation the onshore organization had to the offshore organization during the expedition.

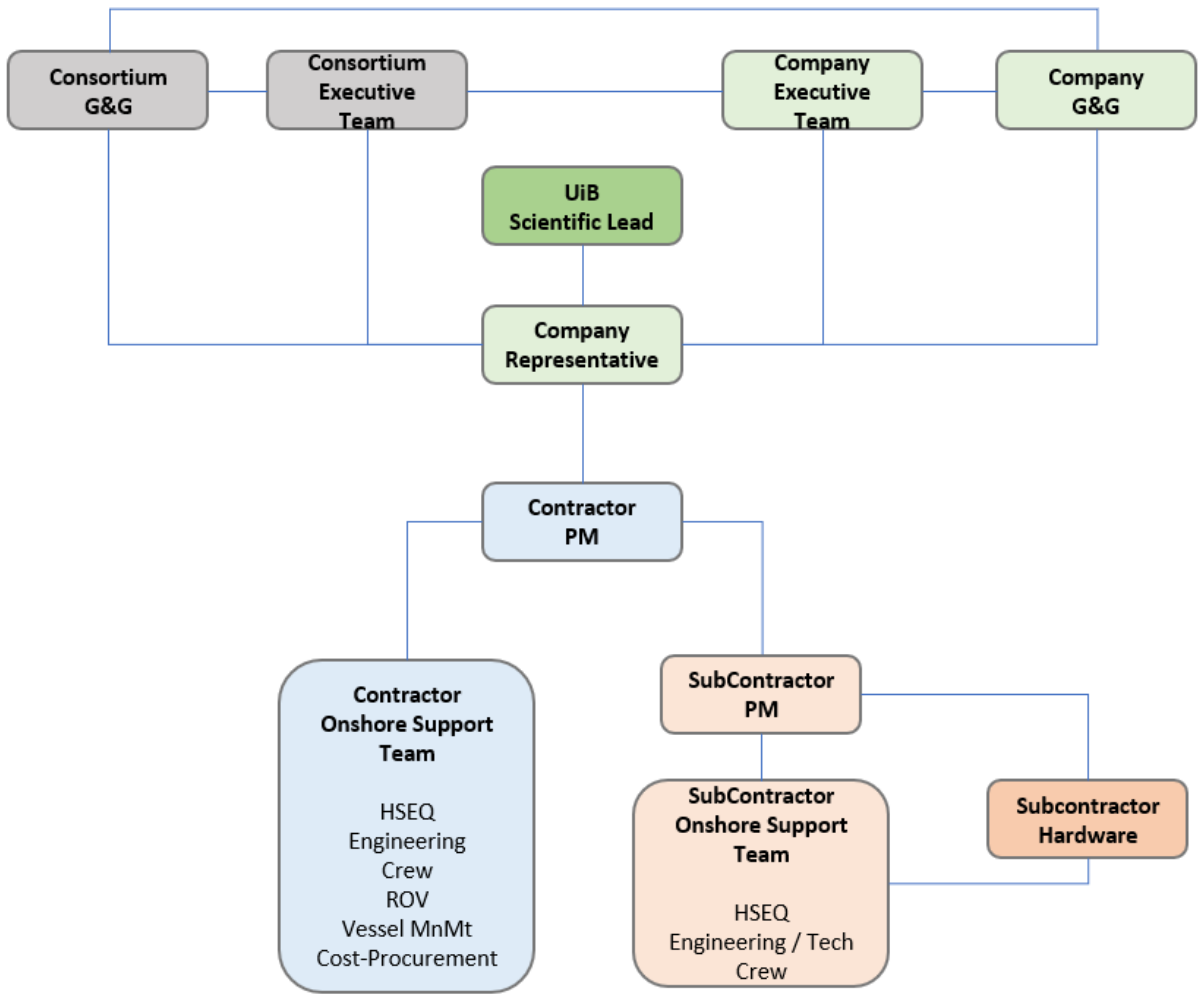


Figure 2: Onshore organization chart for the DI23 expedition.

2.6.1 Contingency Organization.

In case of contingencies, the following contingency organization was defined:

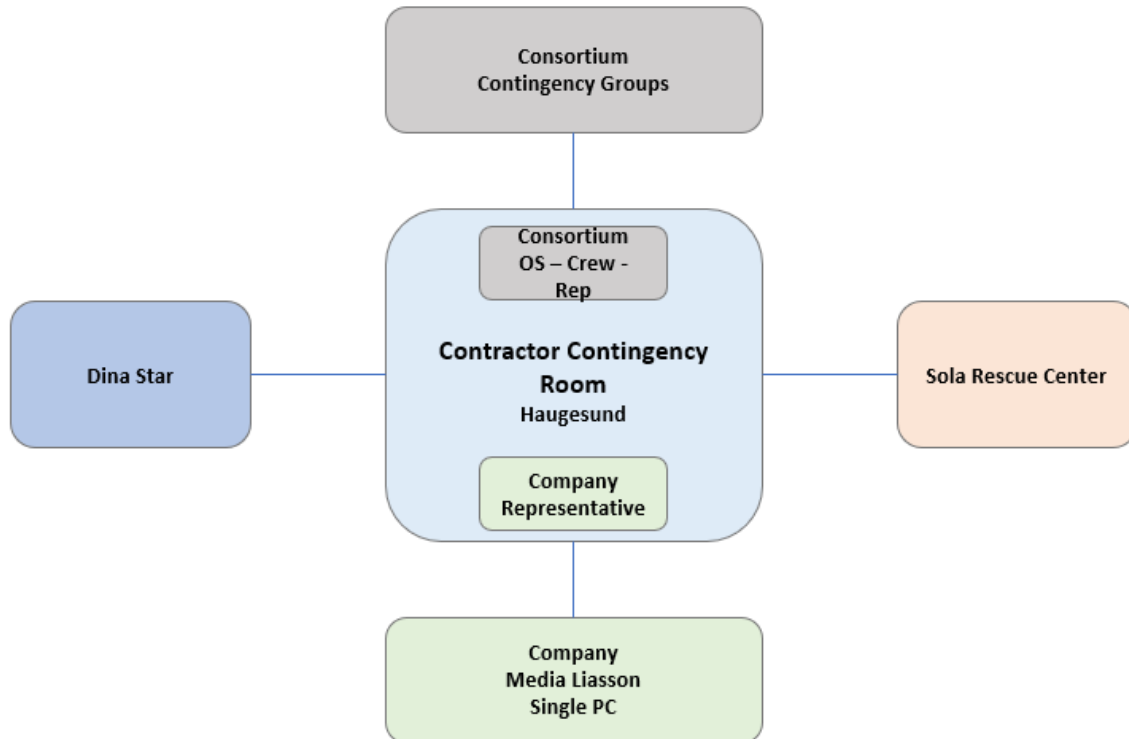


Figure 3: Contingency organization.

2.7 Offshore Organization

The offshore organization consists of several teams with different expertise.

- The Offshore Manager (OM) has the overall responsibility for the daily offshore operations.
- The Project Manager (PM) coordinates activities closely with SS, OM, and shoreside support.
- The Shift Supervisor (SS) communicates with the PM and OM, as well as the offshore crew in the daily support of offshore operations.
- The science team was divided into two different teams – geology and biology.
 - o The geology team was responsible for logging the rock sampling, logging the FlexiCore events, receiving rocks on deck, describing the rocks, and packing the rocks.
 - o The biology team was responsible for sampling when sediment core samples came on deck, sampling fauna samples from both dedicated faunal dives and from potential rocks with fauna.
- ROV teams: responsible for ROV during all ROV operations. ROV operations included supporting FlexiCore operations, sampling operations, video transects etc.
- Marine Crew: The crew working under the captain of the ship. Responsible for sailing and maintenance on the ship.
- Seabed Solutions FlexiCore team: responsible for everything related to the Seabed Excavator and the FlexiCore system.

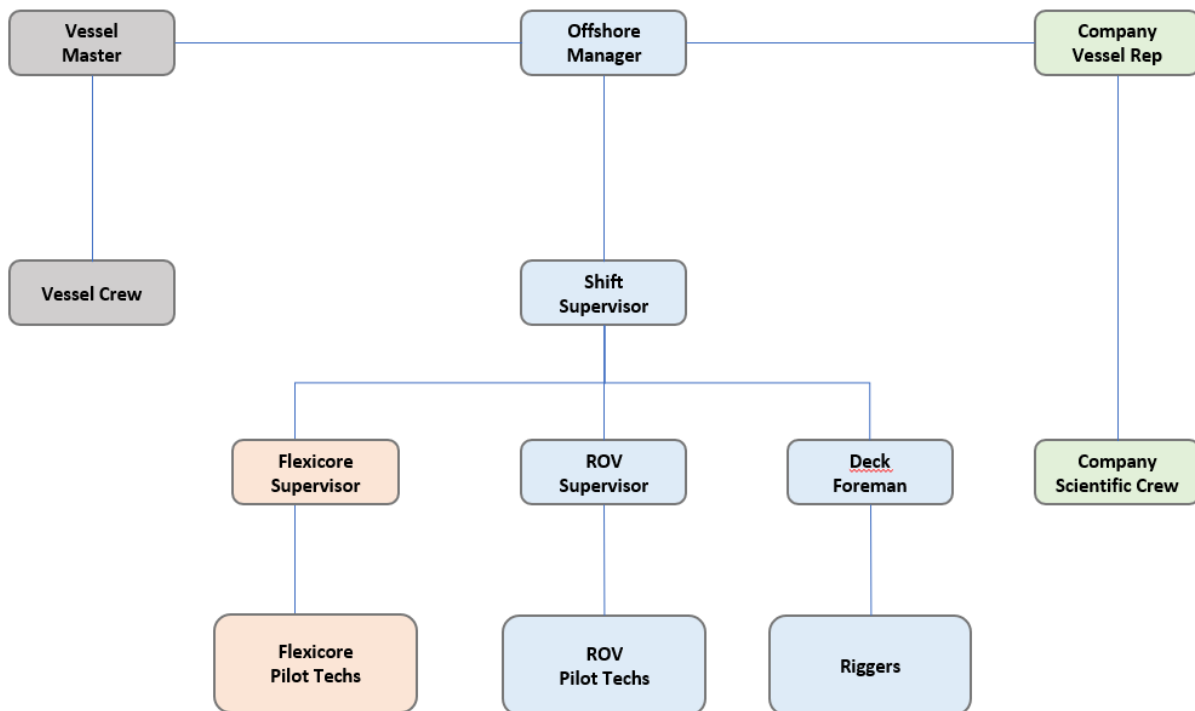


Figure 4: Offshore organization chart for the DI23 expedition.

2.8 Planning

2.8.1 Site plan

The DI23 expedition pre-selected 7 sites for exploration based on their relevance to answering key science questions, our ability to operate at the estimated water depth and slope, and relative proximity of the sites for efficient transit.

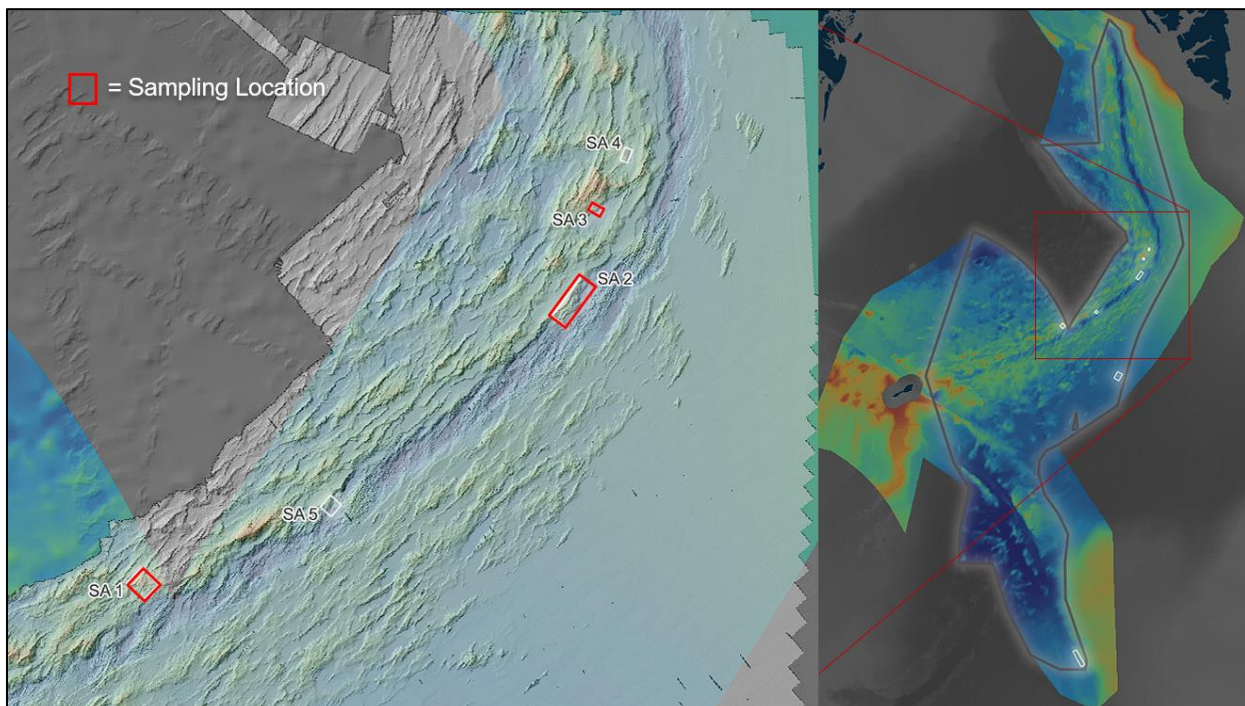


Figure 5: The selected study areas for the expedition are marked with red or white boxes on the map. Red boxes indicate areas of high priority for the expedition, whereas the white boxes represent the remaining sites.

2.8.1.1 Study Area 1 (Shallow Seamount (Figure 2))

- Location of 2022 UiB ROV dive that identified fluid-flow altered basalts on the flank of the seamount.
- Shallow (980m) water depth at summit.
- Possible 'Oceanic Core Complex (OCC)' seafloor features.
- Multiple low-slope regions appropriate for initial FlexiCore operation.
- Previously un-visited area with high benefit for biological sampling outside of the Mohns Ridge Axial Valley.

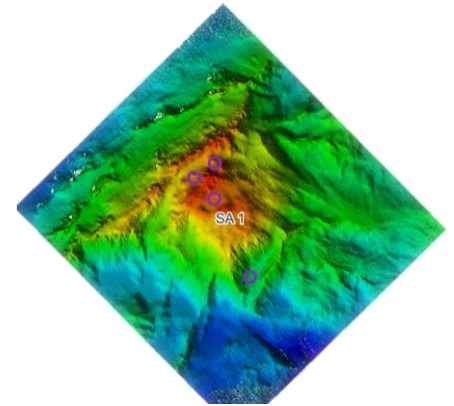


Figure 6: Map of the Shallow Seamount. Locations 1-4 are marked with purple circles on the mount. These locations were all visited during the expedition.

2.8.1.2 Study Area 2 (Mohns Treasure)

- Known site of extinct / inactive hydrothermal deposit.
- Site of the Norwegian Petroleum Directorate (NPD) coring expedition.
- Location for retrieval of known sulphide deposit samples for EMINENT Project sulphide processing tasks.
- Southern-extension of investigation area with basaltic terraces ideal for 'deep test' of coring system at 2600m in relatively flat location.

2.8.1.3 Study Area 3 (Flank of Shultz Massif)

- Area of potential deep oceanic crust exposure within operating depth of expedition systems
- Requires additional site investigation and mapping to determine if area is appropriate for FlexiCore Operations

2.8.1.4 Study Area 4 (Northern OCC)

- Region of high degree of seafloor extension, suggestive of exposed deeper mantle material of scientific interest
- Requires additional site investigation and mapping to determine if area is of scientific interest and appropriate for FlexiCore Operations

2.8.1.5 Study Area 5 (Gnitahei and Fåvne)

- Area of interest for potential EMSO-Mohns observatory deployment
- UiB led operations for observatory deployment and site characterization / instrument location
- No FlexiCore operations possible at site given cable length restrictions

2.8.1.6 Study Area 6 (Manganese Seamount)

- Site of previously sampled manganese crust and sponges
- Possible return to previous locations of crust sampling to assess sampling event impacts on sponges
- Possible understanding of impact of high-intensity, short duration crust plume on benthic fauna

2.8.1.7 Study Area 7 (Vøring Spur)

- Site of previously sampled manganese crust and sponges
- Possible return to previous locations of crust sampling to assess sampling event impacts on sponges
- Possible understanding of impact of high-intensity, short duration crust plume on benthic fauna

2.9 Procedures

For all different procedures during the DI23 expedition, task plans were created to ensure that all procedures were performed as expected.

2.9.1 Mobilization/Demobilization

Mobilization and Demobilization were executed in alignment with HAZOP, Deck Layout and Lifting plans and MOB/DEMOB general and project-specific procedures for the vessel and for each spread as defined by CONTRACTOR and SUBCONTRACTORS.

Mobilization and Demobilization were executed at the CONTRACTOR base in Haugesund.

No serious incidents were observed during MOB or DEMOB.

2.9.2 Operation

A detailed operations plan was developed before the expedition. The plan included the expected time spent at each of the study areas, deployment and recovery of the various platforms, main activities for the dives, transit times and much more. The detailed plan was developed for ideal operational profiles of the equipment, and with a clear acknowledgement that conditions 'on the ground' will dictate the project operations and movement between various study areas. However, due to operations being highly dependent on the weather offshore, expeditions like this must be prepared to change the operations plan rapidly in case of unexpected weather.

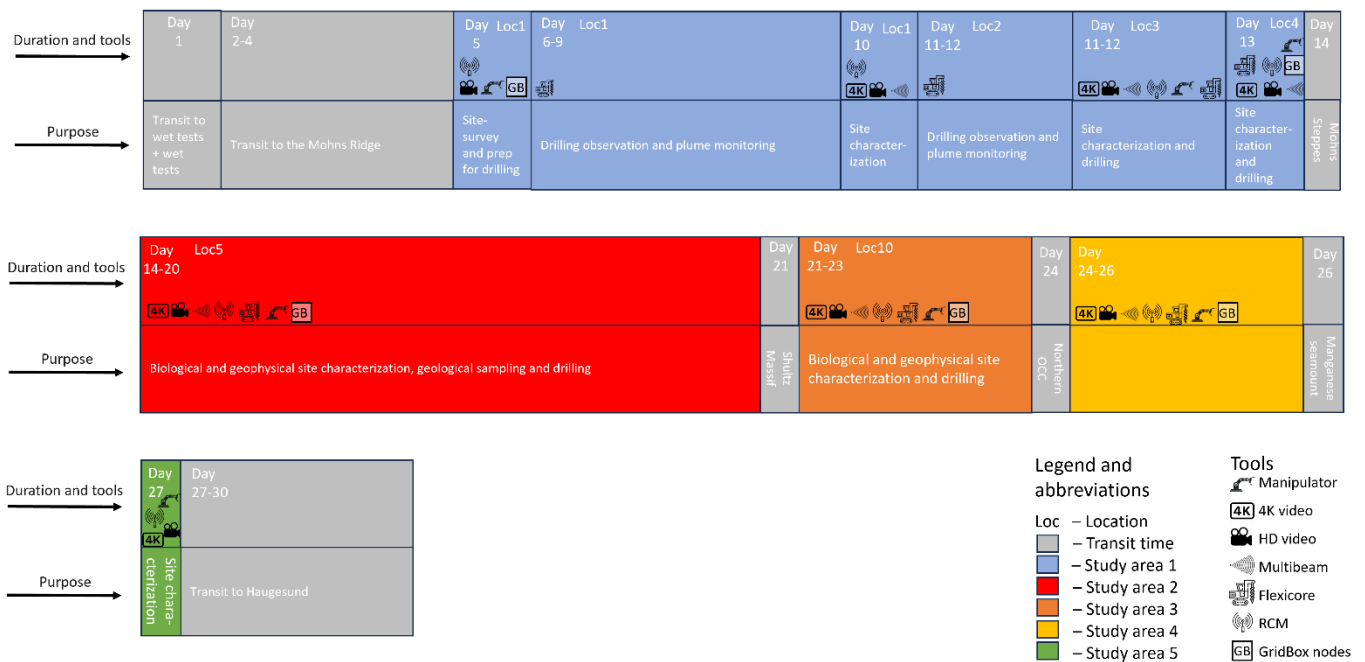


Figure 7: Overview of the planned operations before the DI23 expedition started.

2.9.3 Bio Fauna sampling

Sampling biological fauna in the deep sea is crucial for understanding the diversity, distribution, and ecological roles of marine life in one of the planet's most extreme environments. This includes studying organisms that inhabit deep-sea ecosystems such as hydrothermal vents, cold seeps, deep-

sea trenches, and coral reefs. ROVs used for bio fauna sampling are typically equipped with robotic arms, suction samplers, shovels, and storage boxes or bio-boxes. These tools allow for the careful collection of various marine organisms ranging from macrofauna (like starfish and corals) to microfauna (such as small invertebrates).

During a mission, the ROV is piloted to the target location where the operators use its cameras to locate and identify species of interest. The ROV's manipulator arms or specialized sampling devices are then used to collect the organisms. Care is taken to minimize harm to both the collected species and their habitat.

Once retrieved, the biological samples are studied for various aspects such as species identification, genetic analysis, ecological function, and adaptive mechanisms to deep-sea conditions. This research is vital for understanding life in one of Earth's least explored habitats.

2.9.4 FlexiCore™

The FlexiCore system, deployed with the ship crane and umbilical winch, is used as a bespoke seafloor coring system to sample subsurface material. On this expedition, the system was configured for hard rock coring in variably altered basaltic and potentially sulfidic regions. Other configurations of the system can work with sediment and core into hard rock with sediment overburden.

During mission the system is operated in concert with one ROV and seafloor baskets holding the sample rods, coring rods, and drilling tooling. Once the FlexiCore system is deployed to location the ROV disconnects the ship crane from the FlexiCore and the ship crane is then used to deploy the seafloor basket containing coring equipment.

2.9.5 Instrument deployment

2.9.5.1 RCM-1 and RCM-2

The RCM-1 and RCM-2 systems (Seaguard II from Aanderaa) were deployed with Doppler Current, Turbidity, Oxygen, Conductivity, Pressure, and Temperature sensors. The systems were pre-configured and brought to the ship in operation as the system battery life well-exceeded the deployment duration of 14 to 15 months, so the systems were activated by Aanderaa technicians during expedition mobilization. System settings were confirmed during the operations test in Sognefjord and no modifications were made to the systems prior to deployment. Deployment of the system is by seafloor basket and ROV positioning to confirm both position of the system and appropriate orientation as these systems should be deployed as close to vertical as possible for quality data collection.

2.9.5.2 ADCP

The ADCP Instrument is a 300kHz upwards looking system for imaging the current structure within 100m of the seafloor. The system was configured in close collaboration with Teledyne, the system manufacturer for a 12 month continuous data record. As with the RCM-1 and RCM-2 systems the system settings were verified and example data downloaded from the Sognefjord test. No system modifications were made between the test and final deployment. Deployment of the system was via seafloor basket with the ROV positioning the system at a sufficient stand-off distance to the RCM-1 unit to prevent acoustic interference.

2.9.5.3 Sediment Traps

Two sediment traps were deployed during the expedition, one adjacent to the RCM-1 instrument deployment and one directly adjacent to the rock coring activities. Sediment traps are used to determine 'background' and 'disturbance' levels of sedimentation during coring operations, and also give an understanding of both nutrient and particle flux in a given region. The sediment traps used

were a dual collection tube system with flotation, alignment fin, and a clump weight to collect sediment from a specific cross-sectional area at 1.5m elevation over the seafloor. Both sediment traps were deployed during the initial phase of the expedition and recovered after the termination of coring and ROV sampling operations. On recovery, the sediment tubes could not be capped, so the ROV attempted to maintain steady vertical rise and leave the collection tubes as undisturbed as possible.

2.9.6 Multibeam

Multibeam sonar systems provide high-resolution bathymetric data, creating detailed maps of the seafloor to reveal contours, elevations, and depressions. This capability is crucial for geological surveys, habitat mapping, pipeline inspections, and archaeological explorations. Multibeam sonar systems emit sound waves in a fan-shaped beam that covers a wide swath of the seafloor with the receive array oriented at 90 degrees to the transmit array to create a small ensonified area per beam and high-resolution independent measurements of the seafloor. For this expedition the R2Sonic 2024 dual-head multibeam system was mounted on one of the ROVs in a 'brow-mount' configuration. Positioning information was given by a high frequency doppler velocimeter mounted on the back of the ROV with all navigation information reduced to the center point of the vehicle. Data acquisition and processing was executed in the EIVA software suite. The mobility of the ROV, combined with the multibeam sonar, enables extensive and detailed mapping of underwater features, even in rugged and complex environments.

2.9.7 Video and 4K video

Both standard and 4K video systems on ROVs are used for a variety of purposes in deep-sea exploration. This includes biological surveys, where detailed imagery is used to study marine organisms and their behaviors; geological investigations, such as examining seafloor structures and volcanic activities; and archaeological exploration, including the study of shipwrecks and historical artifacts. Video feeds from ROVs are often transmitted in real-time to operators and researchers on a surface vessel or shore-based station. This immediate access to video footage enables on-the-spot analysis and decision-making during exploration missions.

Traditional video systems on ROVs consist of cameras that capture footage of the underwater environment. These systems are essential for navigation, observation, and documentation during deep-sea missions. The cameras are typically housed in pressure-resistant casings to withstand the extreme conditions of the deep sea, including high pressure and low temperatures.

4K video systems used on the expedition was a Sub-C Imaging Rayfin Mk II 4K camera deployed on one of the ROVs and provided two independent video streams and image capture capability. The primary HD video stream was integrated into the topside video archival system with a permanently set overlay. During specific time intervals 4K video can be recorded internally on the camera in 10-minute intervals, with timing and positioning given on the topside overlay and matched to the overlay-free 4K video. Still images are also opportunistically collected at the discretion of the ROV pilot and operations lead and collected without overlay information.

2.9.8 Pushcores

A pushcore is a cylindrical device made of a clear plastic tube, fitted into a solid aluminum or titanium support sleeve with an ROV-appropriate handle for manipulation. The lower end of the tube is sharpened or bevelled to facilitate penetration into the sediment. During sampling, the pushcore is pushed vertically into the ocean floor by the ROV. The depth of insertion varies depending on deposition but typically ranges from a few centimeters to several tens of centimeters. As the pushcore is pushed into the sediment, it collects a column of sediment that preserves the

stratification and structure. Once the desired depth is reached, the core is carefully pulled out, and a cap may be placed on the bottom end of the tube to seal the sediment column inside. After retrieval, the sediment core is sectioned at different depths for detailed analyses. These analyses can include grain size distribution, chemical composition, and microbiological studies. The data obtained can offer insights into past and present environmental conditions, sedimentation rates, and ecological processes at the seafloor.

2.9.9 Rock sampling

Rock samples from the ocean floor are vital for understanding the geological history and composition of the Earth's crust, particularly in areas like mid-ocean ridges, seamounts, and subduction zones. These samples can reveal information about volcanic activity, tectonic movements, mineral deposits, and the Earth's mantle.

The ROVs are equipped with various tools for rock sampling, such as hydraulic manipulator arms, rock cutters, grinders, and sample baskets or boxes. The manipulator arms are used to break off samples from larger rock formations or to pick up loose rocks from the seabed. During a sampling mission, the ROV is navigated to the desired location on the seafloor. The pilots then use the ROV's cameras and manipulator arms to locate and collect rock samples. The samples are typically placed in secure containers attached to the ROV for safe transport to the surface.

Once brought to the surface, the rock samples undergo various analyses, such as macrobiological, microbiological, petrological, geochemical, and isotopic studies.

2.9.10 Deployment of GridBox

The pearl nodes, provided by ShearWater, are the smallest and lightest ocean bottom seismic nodes on the market today. During the expedition, 20 of these nodes were deployed on the seafloor in close proximity to the FlexiCore coring system. This is part of Adepth's GridBox development program, where the use of seismic nodes – and various acoustic sources are employed in conjunction with coring activity to retrieve high resolution geophysical data for sub-strata modelling of shallow geology/lithology. This application of geophysical sensors is novel and under development by Adepth and partners. Initially, the nodes were supposed to be tested in two different configurations to get an idea of the best way to configure the nodes in relation to one another and in relation to the sound source. First configuration was to have all the 20 nodes mounted on a rope, with a set distance, and lay them out on the seafloor in a long line. The other configuration was to place the nodes on two ropes with ten nodes on each and lay them down in a cross at the seabed. However, due to complications deploying the nodes while on a rope, they were all placed manually, one by one by an ROV in a straight line (similar to the first configuration method, but without the rope in-between all nodes). The cross configuration was therefore never used.

2.10 Risk Management

Risk management was managed by CONTRACTOR, and all parties involved in operations were involved in the risk management work. Stage 1 risk assessment (HIRA) and Stage 2 (HAZOP) risk assessment and mitigation were carried out.

2.10.1 HIRA (S1RA)

Initial HIRA session was carried out prior to quay-side tests, and in follow-up of quay side test in preparation for Mobilization. Scientific Lead, Company, Contractor, and Subcontractors were involved in HIRA.

HIRA was executed in alignment with the “*Stage 1 Risk Assessment Process*”, as employed by CONTRACTOR.

2.10.2 HAZOP (S2RA)

HAZOP was executed prior to Mobilization on April 17th. All parties involved onboard were present at the HAZOP, and all parties had issued procedures for review prior to HAZOP.

HAZOP workshop was executed in alignment with the “*Stage 2 Preliminary Risk Assessment process*” (S2RA).

The S2RA session comprised of the following elements:

- Introduction;
- Technical overview of the SOW;
- Risk Assessment / Discussions;
- Summary of Findings and Action Points.

2.10.3 RISK ASSESSMENT MATRIX & ACCEPTANCE CRITERIA

The Risk Assessment (RA) method and findings were captured and documented in the RAR. All risks identified are categorized according to the DO Risk Assessment Matrix (RAM) and are classified in accordance with the appendage acceptance criteria. Each registered risk is assigned to a responsible person, and a due date is set for all mitigating actions.

The following CONTRACTOR RAM was used during the S1RA and S2RA to classify the identified initial and residual risk:

DeepOcean Risk Assessment Matrix						
Probability	5	10	15	20	25	
	4	8	12	16	20	
3	6	9	12	15		
2	4	6	8	10		
1	2	3	4	5		
		1 Insignificant	2 Minor	3 Moderate	4 Major	5 Catastrophic
Consequence						
Personnel Injury / Illness	First Aid Case / Illness (not serious)	Medical Treatment Case / Restricted Work Case / Illness requires medical attention	Lost Time Injury / Serious illness	Major Injury / Illness / Disablement - Requires intensive hospital treatment	Fatality / Multiple Fatalities / Terminal illness	
Environmental Pollution	Insignificant environmental impact / readily biodegradable substance, Release < 10L	Some environmental change, no lasting impact, Release 10 – 100L	Short term environmental impact, repairable, Release 100 L - 5 m3	Medium term environmental impact, not permanent, Release 5 - 100 m3	Severe environmental impact, permanent, Release > 100 m3	
Cost	Cost Overrun < 50 KUSD	Cost Overrun > 50 KUSD	Cost Overrun > 250 KUSD	Cost Overrun > 0,5 MUSD	Cost Overrun > 1 MUSD	
Schedule	Insignificant schedule delay (e.g. not impacting delivery date)	Minor schedule delay	Moderate schedule delay	Major schedule delay	Catastrophic schedule delay	
Reputation	No reputational impact	Internal negative publicity on website and from Customer	Local/ Regional negative exposure in mass media, Authorities and from Customer	National negative exposure in mass media, Authorities and from Customer	International negative exposure in mass media, Authorities and from Customer	
Acceptance Criteria						
		Acceptable to proceed				
		Acceptable to proceed providing risk is monitored and probability remains unchanged				
		Acceptable to proceed with supervision control and higher management approval				
		Not acceptable to proceed, alternative method required				

Note: The acceptance criteria applies for the residual risk; after the mitigating measures have been implemented

Figure 8: CONTRACTOR Risk Assessment Matrix

All identified risks were minimized to ALARP (As Low As Reasonably Possible) when compared with current normative industry safety levels for the task being proposed. The core aim of the risk management process is to eliminate or minimize potential hazards and control the risk of harm to people, equipment and the environment. It is important to determine the controls that are required to reduce the risk to an acceptable level.

Operations are only to be allowed to proceed when an acceptable level of risk is achieved. To assist with this effort, the ALARP approach shall be used in conjunction with the hierarchy of controls.

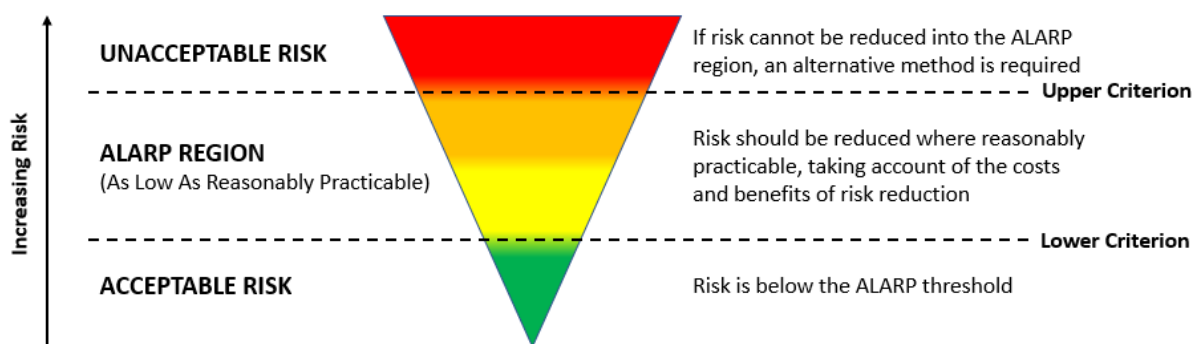


Figure 9: ALARP approach

3 Mobilization

The DI23 Expedition mobilized from Haugesund, Norway beginning on April 30th, 2023. The mobilization was delayed by at least four days due to weather delays on the previous ship operation. This delay had minimal impact on equipment, but significant impact on scientific party participation

and mobilization. The delay affected the mobilization of hydrographic instruments on the INST5 ROV as the installing engineer was not able to meet the ship and affected the biological party participation as work contracts had to be extended several times to allow personnel to join the expedition.

Mobilization tasks ran for the most part smoothly with the welding work only limited by the number of available welders. Of note, however, during mobilization, is that the installation and pre-tensioning of the ROV umbilical was executed over the entire mobilization period and severely restricted crane access to the deck. It is somewhat unclear if this had a direct impact on the mobilization schedule, given the aforementioned limited welding capacity, but it added a clear complication to mobilization activities and required close coordination between crane and shoreside operations. The mobilization was completed on May 3rd.

4 Operation

4.1 Operational summary

After the mobilization was completed on May 3rd, the expedition transited directly to Sognefjord to pressure test the FlexiCore system and hydrographic instruments and test the deep-water calibration of the USBL positioning system. In Sognefjord, the FlexiCore and both ROVs were deployed, along with the 20' basket holding coring equipment, ADCP, and Seaguard II system. While this testing site was overly sedimented to test the driving ability of the Seabed Excavator, it was appropriate for testing the system functionality and ROV operation and interaction with the FlexiCore system and coring components. The test went smoothly with findings mostly related to operational efficiency and launch/recovery operations of the FlexiCore system.

After the Sognefjord test, the expedition transited to the Mohns Ridge to begin work at Study Area 1 after 60 hours of transit. The first operation was to deploy both ROVs and a centrepole basket holding hydrographic instruments and a sediment trap. After deployment of the instruments, both ROVs executed an initial site survey, completing a profile along Locations 3, 1, and 2. This initial survey was designed to evaluate multiple sites for suitability for FlexiCore operations. The survey concluded that Locations 1 and 2 were suitable for operation, and the FlexiCore system was deployed at Location 1.

The initial deployment was interrupted by faulty handling of the system and accidental decoupling of the FlexiCore umbilical. The FlexiCore was recovered to the deck and repaired; in the meantime, the INST 5 executed an environmental site survey. Subsequent deployment of the FlexiCore was successful at Location 1.

On the first deployment operation at Location 1 the FlexiCore system encountered deeper than anticipated sediment and was unable to stabilize in the relatively steep slope. The decision was made to transit the system to Location 2 as that was confirmed to be lower slope. For operational efficiency the system was transited at depth between the two sites and re-deployed at Location 2. This significantly reduced the site-to-site mobilization time, but unfortunately meant that no site environmental survey was executed prior to FlexiCore operation at Location 2.

During the initiation checks and system positioning of the FlexiCore, INST3 deployed 20 Shearwater Pearl seafloor seismic nodes as prescribed by Shearwater and performed a node positioning check on each node. On 9th of May at Location 2 the FlexiCore system executed the first coring operation. The system was equipped with 1.5 m core barrels and cored a total depth of 6m with variable recovery to over 50%. The coring operation took 19 hours before a hydraulic fault on the FlexiCore system interrupted coring and necessitated recovering the system to deck. During the coring operation INST3 was primarily tasked with support of the coring activities and INST5 was acting as backup support and also performing local environmental sampling, rock sampling and sediment coring.

After recovery of the FlexiCore system the troubleshooting process indicated that there were limited spares available of the hydraulic systems that malfunctioned. During the troubleshooting and repair period both INST 3 and 5 were used for environmental sampling, video transects, geological rock sampling and transects to quantify the Study Area 1 location.

After root-cause analysis of the FlexiCore fault the shoreside support team decided that it was possible to repair the system, but that it would require additional equipment sourced from Tromsø. Consequently, operations at Location 2 were suspended on 11th May and the expedition transited to Tromsø for resupply operation and return transit.

The Seabed Solutions group were able to rapidly execute the repair offshore of Tromsø, enabling a rapid turnaround of operations and return to Study Area 1, Location 2 on 13th May after a 36-hour transit. At this point a marginal weather window prevented FlexiCore deployment, so operations shifted to biological and geological investigations while weather allowed ROV operation. The first operation was an environmental video survey matching the specifications executed at Location 1, followed by a video transect of the nodes to confirm stability of the nodes after the repair transit period.

On May 17th a sufficient weather window opened up to launch the FlexiCore and begin coring. This coring operation transitioned to the use of 3 m core barrels and cored about half of a barrel length before a hydraulic fault interrupted operation again. The root-cause analysis of the system fault indicated that an at-sea repair was possible, so the FlexiCore team repaired the system and shifted to waiting on a sufficient weather window for FlexiCore launch.

During the repair and waiting for launch window period both environmental sediment core sampling and geological survey were executed, weather permitting. These surveys included the deployment of the 'deep site' Location 4 Seaguard hydrographic system and biological video transect.

On the next available weather window on the 18th of May the FlexiCore system was again deployed at Core Site 3 and 12m depth of core was executed with variable sample recovery up to 31%. During this coring operation INST5 supported the FlexiCore system and INST3 performed sediment core, rock sampling, and biological sampling.

On the 19th of May the FlexiCore system suffered a similar hydraulic fault and was recovered to deck with the drill string cut and left in the seafloor. On recovery to deck the decision was made to perform a partial system repair and re-deploy. Unfortunately, the weather window was not sufficient for FlexiCore redeployment, so operations focused on biological and geological sampling, weather permitting.

The system was re-deployed on the 21st May in a limited weather window, however the system suffered an accidental separation of the FlexiCore umbilical from the multi-stab connector. Given the limited recovery window and required repair operation, the decision was made to 'wet store' the FlexiCore system and recover the multistab connector for repair and re-deployment. This option both allowed for deployment of the FlexiCore system and a test of the ability of the multistab connector to be used for seafloor re-connection to the system. Repair of the multi-stab was completed well in advance of the next weather window. Given the lack of ship-based scientific instrumentation, all operations were suspended during weather downtime.

On 22nd May a sufficient weather window opened for redeployment of the umbilical and reconnection to the FlexiCore system. The reconnection operation was successful, with power and telemetry connected to the system. However, the hydraulic system did not initiate properly, and the

system was not able to continue coring operations. The weather at this point was out of specification for FlexiCore system recovery, so operations shifted over to focused biological and rock sampling, weather permitting.

After a weather delay the FlexiCore system was successfully recovered on the 23rd of May, along with all remaining equipment deployed at Study Area 1, Location 2 and an extensive faunal sampling dive. The expedition then transited to Study Area 1 Location 1 to recover the sediment trap, finding a fish living in one of the trap tubes. The final operation of the expedition was an attempt to complete the 'deep transect' biological video survey. This attempt ended due to a rapidly rising sea-state, ending operations on DI23 on the 23rd of May.

Subsequent to the successful recovery of both ROVs, the expedition transited to Jan Mayen Island for lee-wind protection from a significant weather event. The expedition resumed transit to Haugesund on the 25th of May but encountered significant weather with wave height over 11m, requiring the ship to go to weather heading and wait out the main storm. Transit was recommenced on the 27th of May and the expedition arrived Haugesund on the 29th of May.

De-mobilization went smoothly with all equipment off the vessel and operations completed on the 30th of May.

A summary of the expedition activity hours is given in Figure 10.

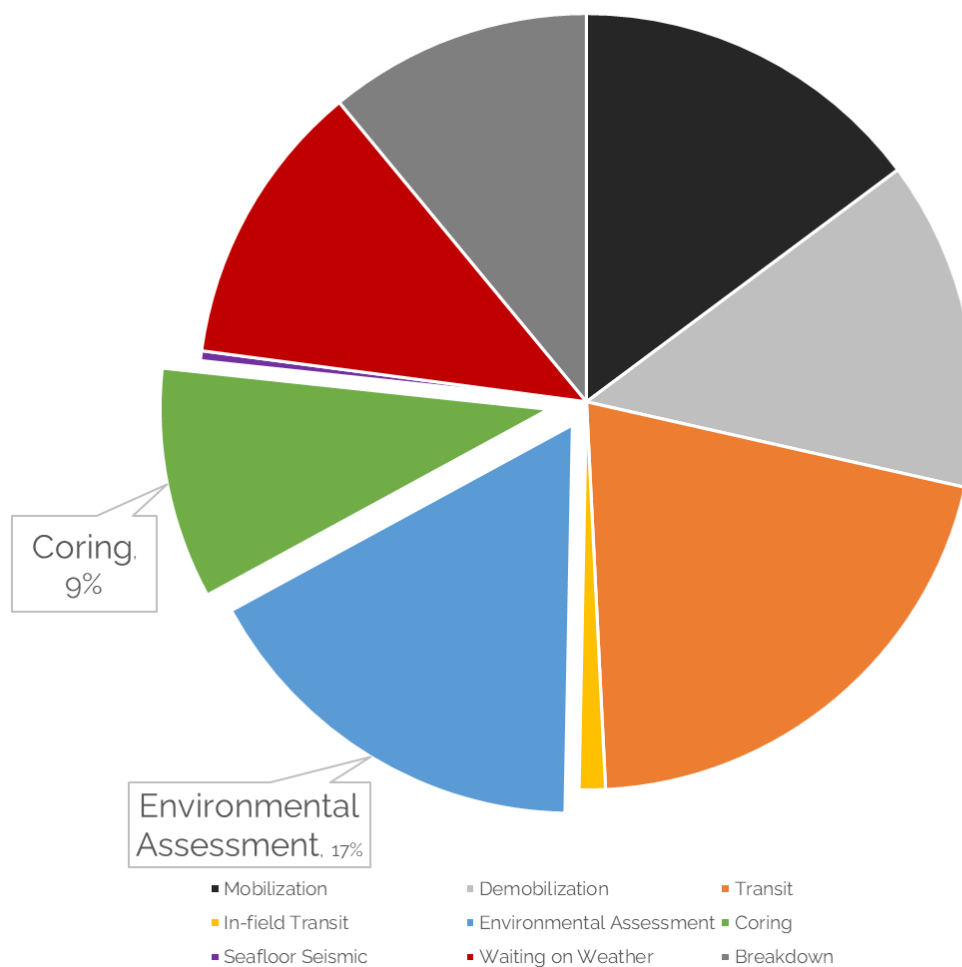


Figure 10: Overview of time spent on different activities during the expedition.

4.2 Platform Operations

The three platforms on the expedition were Installer 3 (INS-3), Installer 5 (INS-5) and the Seabed Excavator (equipped with the FlexiCore). The following subchapter will give a summary of the activities on each dive for the platforms.

INS-3 was intended to be the main ROV supporting FlexiCore operations and geological sampling. Additionally, the ROV ended up participating in biological sampling such as sediment coring and fauna collection. The ROV was always equipped with HD camera and manipulators. Additional tools carried by the were dependent on the specific activity of the dive.

INS-5 was intended to do most of the biological surveys and sampling. After all, the INS-5 ended up participating in geological sampling in addition to this. The ROV was always equipped with 4K camera, RCM instrument and multibeam dual head bathymetric sonars, in addition to ROV manipulators and HD camera. Additional tools carried by the ROV were dependent on the specific activity of the dive.

Additional tools carried by the INS-3, INS-5 and Seabed Excavator is presented in Figure 11 below. An overview of the samples collected, and instruments placed on the seafloor can be found in Figure 12 below.

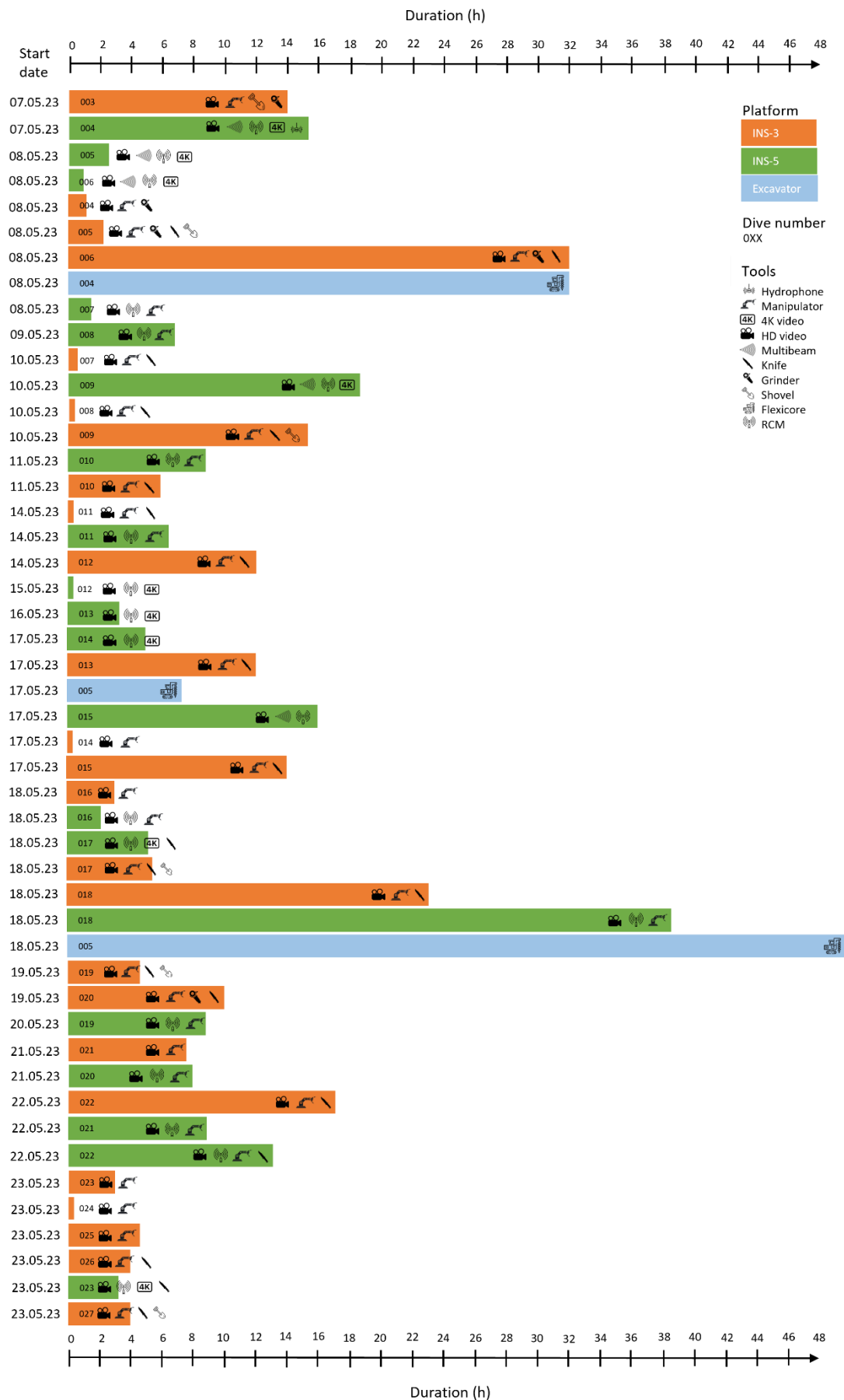


Figure 11: Overview of the duration of dives for all 3 platforms in the water. The tools carried by each platform is presented as symbols on the graph. Symbols are described in the legend.

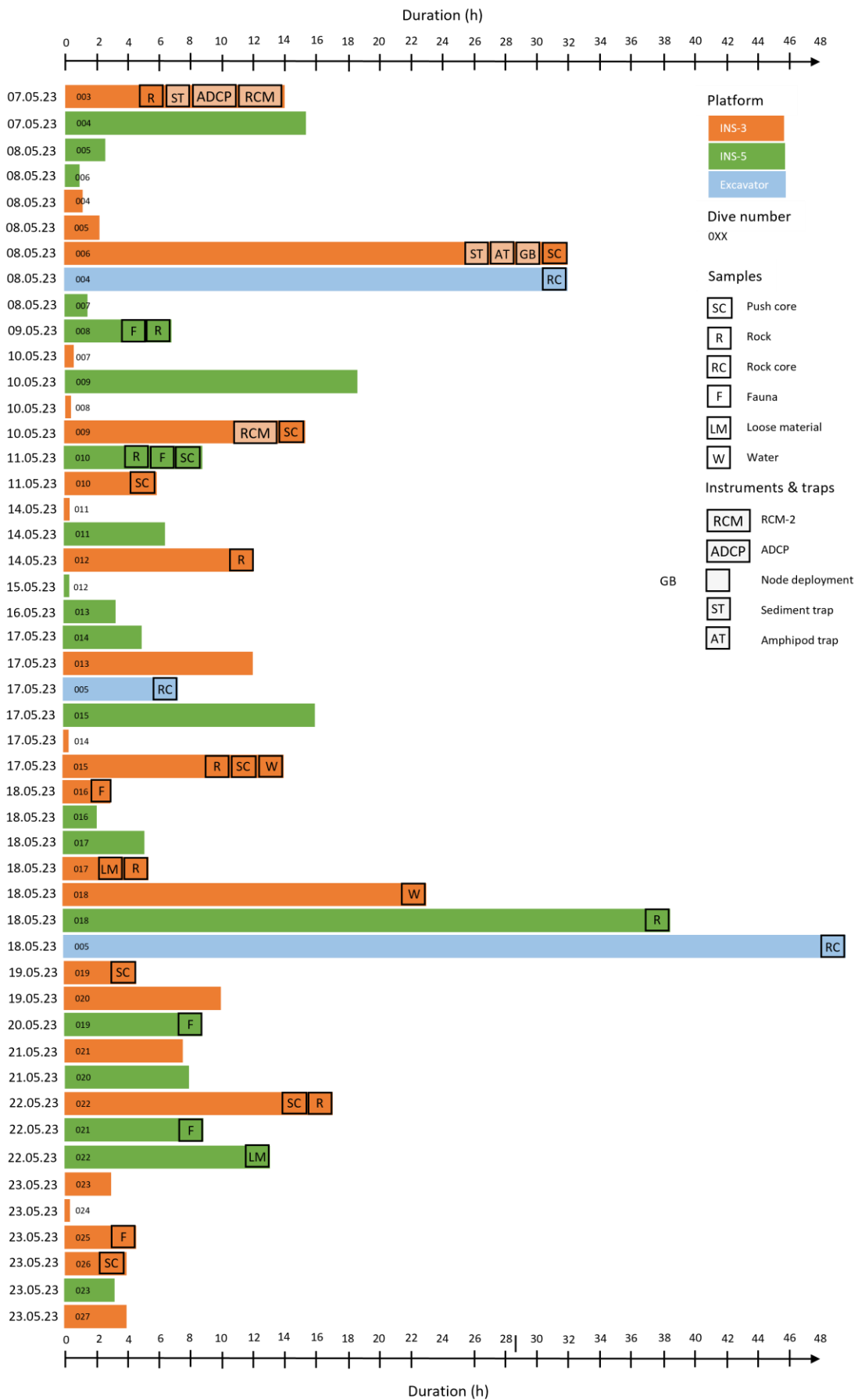


Figure 12: Overview of type of samples collected for the various dives. Additionally, the deployment of instruments and traps are also plotted on this graph. All symbols are described in the legend.

5 Post Processing, Reporting, and results

5.1 Geology

5.1.1 Handheld XRF

A handheld XRF instrument from ThermoFisher was brought on the expedition. The instrument uses X-ray emission onto the surface of a sample and obtains the emitted energy spectrum from each individual element within the range of the instrument. Measured values of each element are given in parts per million or in weight percentage. The instrument was rented from Holger Hartmann, was fully calibrated and ready for use upon delivery.

The main advantage of this instrument is that it allows for fast, non-destructive testing of rock samples both offshore and onshore. No sample preparation is needed to perform analysis – however, if the inside of a rock is the main target, the rock has to be split in two to expose the inside. Ultimately, it gives an indication of the various elements present in the samples. However, there are some limitations related to the instrument:

- Limited sensitivity to light elements. The instrument measures the elements from Mg to U in the periodic table
- Interference between elements of similar energies can occur. This can make it difficult for the instrument to distinguish one element from another in cases where elements with similar spectra coexist
- Lack of quality control
- The instrument measures the top of a sample without penetrating deep, meaning that the results from single spot analysis are not representative of the whole sample
- Small-spot analysis that is not representative of the whole sample

All rock samples and rock core samples were scanned by this instrument, both on- and off-shore (except for some rock samples that were only scanned onshore). The results give an indication of the elemental composition in both the rock and the rock core samples.

5.1.2 Laser Induced Breakdown Spectroscopy (LIBS)

After coming back onshore, selected samples were sent to Elemission, a company in Canada to perform Laser Induced Breakdown Spectroscopy (LIBS) with automated mineralogy on the samples. This is an analytical technique used for elemental analysis of various samples. At Elemission, they perform this LIBS analysis using their own ECORE instrument, where a laser is ablated onto the sample, a plasma is formed, and an emission spectrum from various elements is obtained from the emitted plasma. The biggest advantage of this analysis is that the method is as close as you can get to non-destructive analysis, while giving the distribution of minerals in a sample. The laser penetrates the upper part of each sample, leaving a tiny burn mark. The multi-elemental analysis obtained from the laser ablation is thereafter used to do a quantitative automated mineralogy analysis on the samples. The result of the analysis includes mineralogic maps, density measurements, hardness measurements etc.

Uncertainties of the instrument:

- The uncertainty of minerals detected by the instrument lies between 5-15%. This uncertainty is mainly related to minerals with the same chemical composition, with different ratios of the elements.

- Elemental composition in the samples can be calculated using the stoichiometry of the minerals determined by the instrument. However, since the uncertainty of the mineral detection is between 5-15%, the elemental values calculated can be far from the real value.
- The mineral library used consists of well characterized rocks/crystals that are used as a reference when calibrating the instrument. An analytical procedure for monitoring the drift of the instrument is applied periodically and has not found any instrumental drift.
- In this case, Elemission had to create a new mineral library for this particular scanning because of the sea water present in the samples. As the company is mainly working with on land mining companies in Canada, samples from the seafloor are not a common denominator in their facilities. Na and Cl peaks in the samples were corrected for when comparing the samples from this project to their reference samples.
- Spectra are standardized by attenuating the roughness of the sample based on the uncertainty of the signal. White spaces in mineralogical maps (the category called “other”), cannot be used to estimate the porosity as they can include:
 - Void/empty space such as cracks or pores
 - Areas of no sample material
 - Vague/undefined spectra of one or more minerals.
- Spectra associated to a ‘cell’ in the mineral map may not contain the given mineral only. When the results from laser ablation gives more than one mineral, the most abundant one is chosen automatically by the instrument.

Based on the limitations of this method, further geochemical assay analyses are required to get a full understanding of the elemental ratios in the samples. Assay and work done on i.e. thick sections can give more valuable information regarding the mineralogy of the samples – which can be used to update the results from Elemission at a later stage.

5.1.2.1 *Rock sample results*

A total of 38 rock samples were collected during the DI23 expedition. Of them there were 22 iron oxide samples (consisting mainly of goethite), 3 basalt samples, 6 altered basalt samples, 5 drop stones in addition to 1 completely oxidized sample of unknown nature, and 1 sample not recovered to deck. All samples are collected in Study Area 1, at or around locations 1 and 2. All the rock samples have been scanned with the handheld XRF, and a few selected samples have been scanned with the LIBS ECORE instrument. An overview of the samples collected is given in the Sample Overview: Rock Samples section in the appendix.

- LIBS analyses were performed on three selected samples from the expedition. Sample R012, R018 and R036
 - R012: One of the iron oxide samples that were a bit different from the rest. The rock is oxidized 1-2 cm from the outer crust. The results reveal that the outer part of the rock (the oxidized part) mainly consists of goethite. Two other abundant minerals are pyrite and pyrrhotite. Other minerals found intergrown in smaller amounts are ferrosilite and chamosite.
 - R018: The rock is almost entirely goethite. The other main mineral detected by the LIBS analysis is a pyrolusite. Pyrite and pyrrhotite is also observed in very small amounts.
 - R036: A more complex combination of minerals. The rock is mainly composed of calcite, dolomite (or magnesite), ferrosilite and goethite. Other accessory minerals are also present.

5.1.2.2 *Rock core sample results*

A total of ca. 4 meters of core were recovered from the sub seafloor during the Deep Insight 23 expedition. 3 drilling operations were performed. All drilling locations are from Study Area 1, Location 2. An overview of the samples collected is given in the Sample Overview: Rock Core Samples section in the Appendix

- All core segments (RC001-RC010) were sent to Elemissions lab facilities in Montreal for LIBS and automated mineralogy analysis.
- The automated mineralogy from the LIBS analysis gives an indication of the mineralogy of the core. The mineralogy of the rock samples from the study reveals a diverse composition, including potential host rock minerals, sulfides, and other hydrothermal or altered minerals. The automated mineralogy identified ferrosilite and chamosite as potential altered host minerals, though their exact identification demands further analysis due to their rarity in Mid-Ocean Ridge Basalts and the difficulty in distinguishing chlorite group minerals. The sulfide minerals are predominantly pyrite and pyrrhotite, intergrown throughout the cores, along with copper sulfides such as isocubanite and chalcopyrite, indicative of primary mineralization in hydrothermal systems. Secondary mineralization products, covellite and chalcocite, are also present but require further analysis for accurate differentiation. Additionally, a mix of calcite and dolomite (or possibly magnesite), is found covering the top of the mineral system in the core samples. These carbonates, along with other minerals like barite, amorphous silica, and goethite, are observed in smaller quantities and are typical of hydrothermal or altered minerals from such systems.

5.2 Geophysics

Geophysical data has been QC'd by Shearwater and distributed to project management and partners. The seismic data is now in the process of interpretation in combination with the detailed navigation information for all of the deployed systems (ROVs, Ship, Excavator) and aligned with the coring activities. Initial inspection of the data indicates that multiple complex signals were recorded with sources associated to the vessel, the ROV, and the coring activity. Continued work on this data will focus on deconvoluting these combined signals and creating a subsurface model of this area based on signal information collected. This data processing will be executed through the EMINENT project.

5.3 Microbiology

An overview of the microbiological samples collected during the Deep Insight 23 expedition is presented in Sample Overview: Microbiology Samples in the appendix.

Processing of surface sediment and rocks from the DeepInsight 23 expedition collected for microbial analysis has been underway as of the beginning of November. The 48 extracted samples have yielded very low concentrations of DNA, in the range of 2 - 34 total nanograms of DNA per gram of sample, using standard DNA extraction methods. This amount of DNA is lower than expected for this type of sediment and rock sample and below recommended levels for sequencing work and made gene-specific amplification challenging. Due to potentially insufficient DNA concentrations the decision was made to pursue alternative DNA extraction methods which could result in improved yield and higher quality sequence data.

After initial promising results further testing of the enhanced methods, including DNA sequencing, yielded invalid results. This was partly because the equipment used for measurement of DNA concentration indicated that the alternative DNA extraction method may be the correct approach, as the measurements indicated improved DNA yield, whereas further analysis revealed that this measurement did not properly quantify the amount of sequence-ready DNA. We have updated our procedure to avoid this measurement uncertainty for all future operations.

Microbial DNA extraction will continue, focusing on the use of high-yield extraction methodologies and DNA sequencing techniques sensitive to extremely low abundance sample DNA to complete DNA fingerprinting activities and give an understanding of the microbial diversity and uniqueness of the sampled area.

5.4 Macrobiology

Macrobiological samples have been sent to the appropriate UiB and NORCE laboratories, which will be analysed through the EMINENT project. An overview of the faunal samples retrieved from the cruise and the macro sediment samples can be found in the Sample Overview: Macrobiology Samples section in the appendix.

5.5 Technology Test Results

The DI23 project obtained several key proofs of concept:

1. Subsea Wireline Coring: Fully proven
2. Parallel Subsea Operations in Research Expeditions: Fully Proven
3. Multistab – Subsea connection/disconnection of umbilical: Fully Proven
4. Geophysical Sampling during coring (Grid Box): Partly Proven – to be further developed and optimized

6 Appendix Overview

6.1 License 851/2023

6.2 Sample Overview

1. Faunal Samples
2. Macrobiology samples
3. Microbiology samples
4. Rock core samples
5. Rock samples



(Unofficial translation)

Tillatelse til vitenskapelige undersøkelser etter naturforekomster på den norske kontinentalsokkel mv

Licence for scientific research for natural resources on the Norwegian continental shelf etc

Tillatelsesnr.: 851/2023

Licence no.: 851/2023

- 1 Med hjemmel i § 3 i kgl.res. av 31. januar 1969 med regler om vitenskapelig undersøkelse etter naturforekomster på den norske kontinentalsokkel jf. §§ 2 og 3 i lov av 21. juni 1963 nr. 12, samt Industri og håndverksdepartementets (nå Olje- og energidepartementet) vedtak av 30. mars 1973, meddeler Oljedirektoratet herved:
- 1 Pursuant to Section 3 in Royal Decree of 31 January 1969 relating to Scientific Research for Natural Resources on the Norwegian Continental Shelf etc., cf. Sections 2 and 3 in Act no 12 of 21 June 1963 relating to Exploration for and Exploitation of Submarine Natural Resources, and the Delegation of Authority made by the Royal Norwegian Ministry of Industry and Handicraft (now Ministry of Petroleum and Energy) 30 March 1973, the Norwegian Petroleum Directorate hereby grants:

**Universitetet i Bergen
Senter for dyphavsforskning**

tillatelse til å foreta vitenskapelige undersøkelser etter naturforekomster på den norske kontinentalsokkel mv.

permission to undertake scientific research for natural resources on the Norwegian Continental Shelf, etc.

For tillatelsen gjelder de bestemmelser som er fastsatt i nevnte kgl.res. av 31. januar 1969 nr. 2. For undersøkelser der det gis tillatelse til boring dypere enn 200 meter, må det sendes egen søknad om samtykke i henhold til § 25 i forskrift 29. april 2010 om styring og opplysningsplikt i petroleumsvirksomheten og på enkelte landanlegg (styringsforskriften) til:

For this licence shall apply the regulations set down in the Royal Decree of 31 January 1969 mentioned above. For research, which is licenced to drill deeper than 200 meters below the seabed, a separate application for consent in accordance with Section 25 in the Regulation 29 April 2010 relating to management and the duty to provide information in the petroleum activities and at certain onshore facilities (The Management Regulations), shall be sent to:

Petroleumstilsynet
Postboks 599
4003 Stavanger

Petroleum Safety Authority Norway
P O Box 599
4003 Stavanger, Norway

Der den vitenskapelige undersøkelsen krever andre typer vedtak, må disse foreligge før aktiviteten kan starte opp

If the scientific research requires other permits, these must be obtained before the activity starts.

- 2 Tillatelsen gjelder for følgende områder:

- 2 The licence applies for the following areas:

Som omsøkt

As applied for

Undersøkelsen skal foretas med følgende fartøy:

The survey will be made by the following craft:

Dina Star

Tillatelsen gjelder ikke for områder som det til enhver tid er gitt utvinningstillatelse for, uten at vedkommende rettighetshavers samtykke er innhentet.

The licence does not apply to areas for which production licence is granted, unless permission is obtained from the licence holder.

- Forskrifter om fremmede, ikke-militære fartøyers anløp av og ferdsel i norsk territorialfarvann under fredsforhold, ble fastsatt ved kgl.res. av 23. desember 1994. Det vises til disse bestemmelsene da søknad om tillatelse til anløp av norsk indre farvann for fremmede ikke militære fartøy skal fremmes for norske myndigheter. Søknaden skal rettes til Forsvarets operative hovedkvarter. Det vises også til kgl.res. av 4. mai 1995 om påbudte leder og rapporteringspunkter for fremmede, ikke-militære fartøyers ferdsel i norsk territorial-farvann
- Regulations relating to non-military vessels call at and traffic in Norwegian territorial waters in times of peace were laid down by Royal Decree of 23 December 1994. Reference to these regulations is made because an application for permission to call at Norwegian internal waters has to be put forward to Norwegian authorities. The application shall be addressed to Norwegian National Joint Headquarters. Regarding obligatory fairways and reporting points for non-military vessels traffic in Norwegian territorial waters, cf. Royal Decree of 4. May 1995.
- 3 Vitenskapelige undersøkelser skal foregå på forsvarlig måte i samsvar med de til enhver tid gjeldende bestemmelser. Virksomheten skal ikke i urimelig grad gripe forstyrrende inn i annen virksomhet. Det skal særlig påses at virksomheten ikke i urimelig grad vanskeliggjør eller hindrer skipsfart, fiske eller luftfart, og at den ikke volder skade eller fare for skade på undersjøiske kabler eller andre undersjøiske installasjoner. Særlig aktsomhet skal utvises for å unngå skade på dyre- eller plantelivet i havet, forurensning av havbunnen, dens undergrunn, havet eller luften.
- 3 Scientific research must be carried out in a safe manner in accordance with the regulations in force at all times. The activities must not interfere to an unreasonable degree with other activities. Particular care must be taken to avoid any unreasonable impediment or nuisance to shipping, fishing, and aviation and to avoid damage or risk of damage to underwater cables or other underwater installations. Special care must be taken to avoid damage to marine life and to avoid pollution of the seabed and its subsoil, the sea and the air.
- 4 Når undersøkelsene foretas med fartøy eller luftfartøy, skal de rette seg etter de til enhver tid gjeldende internasjonale og norske sjøveis- henholdsvis luftfartsregler for vedkommende område.
- 4 Reconnaissance vessel and aircraft must comply with the international and Norwegian rules and regulations in force at any time for navigation and aviation in the area concerned.
- Fartøy skal, i nødvendig utstrekning, være kjent med de norske bestemmelser for merking av flytende og faststående fiskeredskap, samt med reglene for lanterneføring hos fartøyer som driver tråling eller annet fiske.
- To the extent deemed necessary, such vessels must know the Norwegian rules for the marking of floating and stationary fishing gear and the rules relating to light signals to be carried by vessels engaged in trawling and other fishing.
- Fartøy skal holde seg i forsvarlig avstand fra fartøy som driver fiske, og fra faststående og flytende fiskeredskap. Særlig aktsomhet skal utvises når større ansamlinger av fiskefartøyer observeres.
- Reconnaissance vessels must keep at a safe distance from vessels engaged in fishing and from floating and stationary fishing gear. Particular care must be taken when fleets of fishing vessels are observed.
- Fartøy skal følge anvisninger fra norsk marinefartøy, kystvaktfartøy eller bruksvaktfartøy.
- Reconnaissance vessels shall follow instruction given by Norwegian naval vessel, coast guard vessel or patrol cutter.
- 5 Med mindre annet framgår, gjelder gir tillatelsen rett til å foreta:
- 5 The licence entitles the licensee to carry out:
- a) magnetiske undersøkelser
- a) magnetic surveys
- b) elektromagnetiske undersøkelser
- b) electromagnetic surveys
- c) gravimetrisk undersøkelser
- c) gravimetric surveys
- d) seismiske undersøkelser
- d) seismic surveys
- e) varmestømsmålinger
- e) heatflow measurements
- f) radiometriske målinger
- f) radiometric measurements
- g) Data som beskriver sjøbunnens topografi (batymetri)
- g) Data describing seabed topography (bathymetry)
- h) undersøkelser hvor man tar prøver av havbunnen eller dens undergrunn, allikevel ikke undersøkelser som medfører boring dypere enn 25 m under havbunnen uten særskilt vedtak.
- h) sampling of the seabed or its subsoil, provided that drilling deeper than 25m is not involved without a separate decision.
- 6 Ved seismiske undersøkelser skal kildetype, kammervolum og samlet energimengde være godkjent.
- 6 If the research involves seismic equipment the seismic source, the volume of the chamber(s) and the amount of energy emitted shall be approved.
- 7 Underretning om
- 7 Information regarding

Dette brevet er godkjent elektronisk i Oljedirektoratet og har derfor ingen signatur

- a tidsangivelse for undersøkelsene
- b undersøkelsesfartøyets navn
- c undersøkelsesfartøyets fart
- d lengde på eventuell seismisk kabel
- e nøyaktige opplysninger om området for undersøkelsen med posisjonslinjer

- a time for the survey
- b name of the vessel
- c speed of the vessel during the survey
- d length of the seismic cable
- e exact information about the area where the survey is performed, including position lines

skal kunngjøres i Etterretninger for sjøfarende
E-post: efs@kartverket.no
Post: Kartverket Sjødivisjonen, Postboks 60, 4001 Stavanger, før oppstart av undersøkelsen.

are to be announced in Etterretninger for sjøfarende (Notice to Mariners),
E-mail: efs@kartverket.no
Mail: The Norwegian Hydrographic Service, PO Box 60, 4001 Stavanger, before the survey is commenced.

- 8 Mens undersøkelsen pågår, skal rettighetshaveren gi ukentlig melding om tid og sted for undersøkelsene, undersøkelsesfartøyets bevegelser, siste ukes produksjon og eventuelle anløp i norsk indre farvann.

- 8 During the survey, the licensee shall give weekly information as to time and place for the survey, the movements of the survey vessel, last week's production and call at Norwegian internal waters.

Umiddelbart etter undersøkelsens avslutning skal rettighetshaver sende sluttmelding.

The licensee shall immediately after completion of the survey report on its termination.

Ukerapportene og sluttmeldingen sendes med e-post til:

The weekly reports and the termination report are to be sent with e-mail to:

- a) Oljedirektoratet
Postboks 600
4003 Stavanger
Epost: postboks@npd.no

- a) The Norwegian Petroleum Directorate
P.O Box 600
4003 Stavanger
Email: postboks@npd.no

- b) Fiskeridirektoratet
Postboks 185 Sentrum
5804 Bergen
Epost: postmottak@fiskeridir.no

- b) The Directorate of Fisheries
P.O Box 185 Sentrum
5804 Bergen
Email: postmottak@fiskeridir.no

- c) Forsvarets operative hovedkvarter
Reitan, Postboks 33
8058 Tverlandet
Epost: csc@coass.mil.no

- c) Norwegian National Joint Headquarters
Reitan, P.O Box 33
8058 Tverlandet
Email: csc@coass.mil.no

- 9 Oljedirektoratet skal ha tilsendt følgende data vederlagsfritt så snart de foreligger, seinest innen ett år etter undersøkelsen ble avsluttet:

- 9 The Norwegian Petroleum Directorate shall be forwarded the following data as soon as they are available, not later than a year after finalization of the survey:

- a) Prosesserte seismiske data, hastighetsdata og navigasjonsdata i digitalt format.

- a) Processed seismic data, velocity data and navigation data in digital format.

Prosesserte seismiske data og hastighetsdata skal ved levering være i overensstemmelse med internasjonale standarder for seismiske data, fortrinnsvis "SEG-Y".

Processed seismic data and velocity data shall at delivery be in accordance to international standards for seismic data, preferably "SEG-Y".

Navigasjonsdata skal være overensstemmende med internasjonale standarder, fortrinnsvis "UKOOA".

Navigation data shall be delivered in accordance to international standards, preferably "UKOOA".

Dataformatene som er benyttet må være beskrevet i oversendelsen.

The formats used when delivering the data shall be described in the submission.

- b) Prosesserte gravimetrisk og magnetiske data i digitalt format.

- b) Processed gravimetric and magnetic data in digital format.

- c) Kart i digitalt format av:
 - Bouguer-anomalier
 - Free-air anomalier

- c) Maps in digital format of:
 - Bouguer anomalies
 - Free-air anomalies

Dette brevet er godkjent elektronisk i Oljedirektoratet og har derfor ingen signatur

- | | |
|---|---|
| <p>- Total magnetisk intensitet</p> <p>d) Prosesserte seismiske refraksjonsmålinger i digitalt format.</p> <p>e) Grunnseismiske profiler i et format som er vanlig i den seismiske industrien.</p> <p>f) Data som beskriver sjøbunnens topografi (batymetri) og hardhet, herunder data innsamlet ved bruk av multistråle ekkolodd og bunnpenetrerende ekkolodd samt data fra øvrige sensorer som kreves for prosessering av denne type data.</p> <p>g) Analyseresultater, kart og profiler som fremstiller resultatene fra andre geofysiske eller geologiske undersøkelser som varmemestrømsmålinger for undergrunnen og temperaturmålinger i vannsøylen, radiometriske målinger, elektromagnetiske målinger, elektrotelluriske målinger</p> <p>h) Rapporter over analyseresultater fra prøvetaking, fra sedimenter, bergarter, mineraler og andre prøver som knyttes til havbunnens beskaffenhet</p> <p>i) Rapporter over levende organismer som regnes som kontinentalsokkelressurser</p> | <p>- Total magnetic intensity</p> <p>d) Processed seismic refraction data in digital format.</p> <p>e) Shallow seismic reflection profiles in a format commonly used in the seismic industry.</p> <p>f) Data describing seabed topography (bathymetry) and hardness. This includes data acquisition by multibeam echosounder and sub-bottom profiler, as well as additional sensor data needed for processing these data.</p> <p>g) Analytical results, maps and sections compiled from other geophysical/geological surveys such as heat flow measurements of the underground and temperature measurements of the water column, radiometric measurements, electromagnetic measurements, electrotelluric measurements, bottom sampling etc.</p> <p>h) Analysis reports from sediments, rocks, minerals and any other samples taken in regards to examining the nature of the seabed</p> <p>i) Reports on living organisms classified as continental shelf resources</p> |
|---|---|

I tillegg kan Oljedirektoratet kreve at kopier av andre vesentlige felldata, video og registreringer, samt prøver av det innsamlede materiale tilstilles direktoratet vederlagsfritt.

In addition, the Norwegian Petroleum Directorate may require that other main data, recordings and samples of collected materials shall be forwarded to the Directorate free of charge.

Addressat:

Oljedirektoratet
 Prof. Olav Hanssensvei 10
 Postboks 600
 Email: postboks@npd.no

Addressee:

Norwegian Petroleum Directorate
 Prof. Olav Hanssensvei 10
 Postboks 600
 Email: postboks@npd.no

- | | |
|--|--|
| <p>10 Direktoratet eller den det bemyndiger, har rett til når som helst å delta i eller være representert i de undersøkelser som foretas etter denne tillatelse.</p> <p>Herunder skal offentlig inspektør ha rett til når som helst og så lenge det anses hensiktsmessig, å medfølge undersøkelsesfartøyet for å påse at undersøkelsene foretas i overensstemmelse med gjeldende regler og vilkår.</p> <p>Inspektøren har rett til å oppholde seg om bord så lenge han finner det nødvendig. Såfremt det finnes nødvendig skal fartøyet anløpe norsk havn for å ta om bord eller sette i land inspektøren.</p> | <p>10 The Directorate or the assigned has a right - at all times - to participate in or to be present at the surveys that take place within this permit.</p> <p>Thus, a government official (inspector) has the right - at any time - to accompany the survey vessel to make sure the surveys are performed in correspondence with current rules and regulations.</p> <p>The inspector has the right to stay on board as long as he finds it necessary. When it is found necessary the vessel is to call on Norwegian port in order to take on board or set ashore an inspector.</p> |
| <p>11 a) Rapport fra feltarbeidet foretatt under denne tillatelsen skal oversendes Oljedirektoratet så snart den foreligger, seinest et halvt år etter at undersøkelsen er avsluttet.</p> <p>b) Forskningsresultater som oppnås ved denne tillatelse skal publiseres i anerkjent vitenskapelig publikasjon eller på annen måte (e.g. intern rapport hos</p> | <p>11 a) A report from the fieldwork carried out in accordance with this licence shall be forwarded to The Norwegian Petroleum Directorate immediately after its finalization, not later than half a year after the end of the cruise.</p> <p>b) Research results shall be published in a recognised scientific publication or in other manner (e.g. internal report with the organization holding the licence). Such</p> |

Dette brevet er godkjent elektronisk i Oljedirektoratet og har derfor ingen signatur

rettighetshaver). Slike publikasjoner skal oversendes Oljedirektoratet vederlagsfritt så snart de foreligger.

publications shall be submitted free of charge to the Directorate immediately after publishing.

Rapporteringen nevnt under pkt a og b over skal fortrinnsvis skje i et vanlig tilgjengelig digitalt format.

The reporting stated under pts a and b shall preferably take place in a commonly used digital format.

Kartverk, Sjødivisjonen, Postboks 60, 4001 Stavanger vil motta informasjon gitt under punkt 9 bokstav f.

Kartverket, Sjødivisjonen (Norwegian Mapping Authority, The Norwegian Hydrographic Service) PO Box 60, N-4001 Stavanger will be the recipient for the information listed in chapter 9, letter f.

Innehaver av denne tillatelsen, eventuelt den viteskapelige ansvarlige har enerett til publisering av forskningsresultatene i 4 år fra feltarbeidet er avsluttet.

The holder of this licence has exclusive right to publish the research results for 4 years after completion of the field-work.

Alle data som nevnt i pkt 9 skal være offentlig tilgjengelige seinest 4 år fra feltarbeidet er avsluttet. Oljedirektoratet kan bestemme noe annet i den enkelte tillatelse, herunder avkorte fristen etter en konkret vurdering.

There shall be public access to all data mentioned in paragraph 9 after 4 years after completion of fieldwork. The Norwegian Petroleum Directorate has the authority to deviate from this when deemed necessary, including shortening the time frame.

12 En kopi av denne tillatelsen skal forefinnes på undersøkelsesfartøyet. Rettighetshaver skal kjenne til relevant norsk lovgivning og er forpliktet til å forvise seg om at kapteinen på fartøyet kjenner tillatelsens innhold og norsk lovgivning av betydning for aktiviteten.

12 A copy of this licence is to be found aboard the survey vessel. The licensee is obliged to know the relevant Norwegian legislation, and to ensure that the captain of the craft knows the contents of the licence and the current legislation relevant for the activities.

13 Denne tillatelsen gjelder

13 This licence is valid

Fra **15. april, 2023**
Til **31. mai, 2023**

From **April 15, 2023**
To **May 31, 2023**

Stavanger, 17.4.2023

Kirsti Herredsvela e.f.
juridisk rådgiver

Ellen M. Skartveit
rådgiver

6.2.1 Fauna samples

Table 1: Overview of the faunal samples collected during DI23. The 'Description' column is a preliminary description of the species collected. When processing of these samples onshore, certain species might be clarified.

Sample ID	Location	Latitude	Longitude	Depth	Description	Data	Data type
F001	Location 2	72.524143	1.494708	1056	Sampling the large sponge that was sitting next to the flexicore drilling, putting it in the belly basket		
F002	Location 2	72.524639	1.495479	1062	Amphipods: 1 x Furrythenes gryllus, 23 x other Lysianassids	F002-PB001	Preservation-biology
F003	Location 2	72.523887	1.494315	1076	Schaudinia/Trychasterina	F003-PB001	Preservation-biology
						F003-GB001	Genetics- biology
						F003-GB002	Genetics- biology
F004	Location 2	72.523972	1.493099	1077	Schaudinia/Trychasterina	F004-PB001	Preservation-biology
						F004-GB001	Genetics- biology
						F004-GB002	Genetics- biology
F005	Location 2	72.524159	1.493658	1078	Asconema sampled, not recovered to deck	-	-
F006	Location 2	72.524168	1.493927	1074	Soft coral sampled	F006-PB001	Preservation-biology
F007	Location 2	72.523912	1.494363	1075	Starfish sampled, not recovered to deck	-	-
F008	Location 2	72.523911	1.494416	1074	Schaudinia/Trychasterina	F008-PB002	Preservation-biology
						F008-PB003	Preservation-biology
						F008-GB001	Genetics- biology
F009	Location 2	72.524049	1.495873	1090	Asconema sampled, but not recovered to deck	-	-
F010	Location 2	72.524164	1.496358	1108	Schaudinia/Trychasterina	F010-PB001	Preservation-biology
						F010-PB002	Preservation-biology
						F010-GB001	Genetics- biology
F011	Location 2	72.524047	1.496484	1103	Demosponge	F011-PB001	Preservation-biology
						F011-GB001	Genetics- biology
F012	Location 2	72.523982	1.496333	1096	Demosponge sampled, but not recovered to deck	-	-
F013	Location 2	72.523953	1.496193	1093	Cladorhizid sampled, not recovered to deck	-	-
F014	Location 2	72.523959	1.496193	1091	Asteroidea (sea star)	F014-PB001	Preservation-biology

						F014-GB001	Genetics- biology
F015	Location 2	72.523959	1.496193	1091	Cnidaria: Hydrozoa- Bycatch (no location, time or depth data)	F015-PB001	Preservation- biology
						F015-PB002	Preservation- biology
						F015-GB001	Genetics- biology
F016	Location 2	72.523959	1.496193	1091	Gastropod sampled- Bycatch (no location, time or depth data)	F016-GB001	Genetics- biology
F017	Location 2	72.523959	1.496193	1091	Cladorhizid sponge sampled- Bycatch (no location, time or depth data)	F017-GB001	Genetics- biology
F018	Location 2	72.523959	1.496193	1091	Sample lost in transit to the surface	-	-
F019	Location 2	72.524169	1.490418	1055	Asconema cf. foliata; subsamples in EtOH, RNA-later, -80°C; bulk remains at -80°C	F019-PB001	Preservation- biology
						F019-GB001	Genetics- biology
						F019-GB002	Genetics- biology
						F019-GB003	Genetics- biology
F020	Location 2	72.524204	1.494179	1053	Soft coral: whole specimen in EtOH	F020-PB001	Preservation- biology
F021	Location 2	72.524169	1.490418	1055	Pycnogonid in EtOH; bycatch but likely to have been taken with F019; position of that sample used here.	F021-PB001	Preservation- biology
F022	Location 2	72.524279	1.494160	1054	Small Cladorhizids (x3) picked from base of a lost Schaudinia sample (rock and minimal base of sponge remained. EtOH.	F022-PB001	Preservation- biology
F023	Location 2	72.524279	1.494160	1054	Soft coral picked from base of a lost Schaudinia sample (rock and minimal base of sponge remained). EtOH.	F023-PB001	Preservation- biology
F024	Location 2	72.524176	1.494909	1057	Schaudinia / Trychasterina; subsamples in EtOH and -80°C; bulk at -80°C	F024-PB001	Preservation- biology
						F024-GB001	Genetics- biology
						F024-GB002	Genetics- biology
F025	Location 2	72.524143	1.494891	1057	Schaudinia / Trychasterina; subsamples in EtOH and -80°C; bulk at -80°C	F025-PB001	Preservation- biology
						F025-GB001	Genetics- biology
						F025-GB002	Genetics- biology

F026	Location 2	72.524136	1.494926	1058	Sample lost from ROV in transit to surface	-	-
F027	Location 2	72.52418	1.494908	1057	Sample lost from ROV in transit to surface	-	-
F028	Location 2	72.524198	1.494820	1056	Schaudinia / Trychasterina; subsamples in EtOH and -80°C; bulk at -80°C	F028- PB001	Preservation- biology
						F028- GB001	Genetics- biology
						F028- GB002	Genetics- biology
F029	Location 2	72.523971	1.494624	1056	Asconema cf. foliata; subsamples in EtOH and - 80°C; bulk in EtOH	F029- PB001	Preservation- biology
						F029- GB001	Genetics- biology
						F029- GB002	Genetics- biology
F030	Location 2	72.524008	1.495147	1059	Sample lost from ROV in transit to surface.	-	-
F031	Location 2	72.524028	1.495231	1061	Schaudinia / Trychasterina; subsamples in EtOH and -80°C; bulk in EtOH	F031- PB001	Preservation- biology
						F031- GB001	Genetics- biology
						F031- GB002	Genetics- biology
F032	Location 2	72.524028	1.495231	1061	Gastropod; EtOH	F032- PB001	Preservation- biology
F033	Location 2	72.524057	1.495233	1061	Sample lost from ROV in transit to surface	-	-
F034	Location 2	72.524028	1.495231	1061	Starfish; arm tip x1 EtOH; remains at -80°C	F034- PB001	Preservation- biology
						F034- GB001	Genetics- biology
F035	Location 2	72.524050	1.495259	1060	Demosponge; subsamples in EtOH and -80°C; bulk remains in EtOH	F035- PB001	Preservation- biology
						F035- GB001	Genetics- biology
						F035- GB002	Genetics- biology
F036	Location 2	72.524045	1.495181	1069	Pycnogonid; EtOH	F036- PB001	Preservation- biology
F037	Location 2	72.524055	1.495212	1059	Pycnogonid; EtOH	F037- PB001	Preservation- biology
F038	Location 2	72.524160	1.495047	1059	Starfish; arm tip x1 EtOH; remains at -80°C	F038- PB001	Preservation- biology
						F038- GB001	Genetics- biology
F039	Location 2	72.524137	1.495059	1059	Cladorhizid; EtOH	F039- PB001	Preservation- biology
F040	Location 2	72.524137	1.495059	1059	Schaudinia / Trychasterina; subsamples in EtOH and -80°C; remains in EtOH	F040- PB001	Preservation- biology
						F040- GB001	Genetics- biology

						F040-GB002	Genetics- biology
F041	Location 2	72.524137	1.495059	1059	Stylocordyla borealis; piece in EtOH; remains at -80°C	F041-GB001	Genetics- biology
						F041-GB002	Genetics- biology
F042	Location 2	72.524086	1.494677	1055	Shark / ray egg case (empty);EtOH	F042-PB001	Preservation- biology
F043	Location 2				Sample lost from ROV in transit to surface	-	-
F044	Location 2	72.524761	1.495700	1078	Cladorhizid; subsamples in EtOH, RNA-later, -80°C; bulk remains in EtOH	F044-PB001	Preservation- biology
						F044-GB001	Genetics- biology
						F044-GB002	Genetics- biology
						F044-GB003	Genetics- biology
F045	Location 2	72.524759	1.495665	1078	Demosponge; subsamples in EtOH and RNA-later, -80°C half specimen	F045-GB001	Genetics- biology
						F045-GB002	Genetics- biology
						F045-GB003	Genetics- biology
F046	Location 2	72.524741	1.493483	1081	Demosponge; subsamples in EtOH and -80°C; bulk remains in EtOH	F046-PB001	Preservation- biology
						F046-GB001	Genetics- biology
						F046-GB002	Genetics- biology
F047	Location 2	72.523785	1.494625	1083	Demosponge, lost in transit	-	-
F048	Location 2	72.524741	1.493483	1081	Glass sponge; subsamples in EtOH, RNA-later, -80°C; bulk remains in EtOH	F048-PB001	Preservation- biology
						F048-PB002	Preservation- biology
						F048-GB001	Genetics- biology
						F048-GB002	Genetics- biology
F049	Location 2	72.524724	1.493548	1081	Schaudinia / Trychasterina; subsamples in EtOH, -80°C, RNA-later; bulk split between EtOH and -80°C	F049-PB001	Preservation- biology
						F049-PB002	Preservation- biology
						F049-GB001	Genetics- biology
						F049-GB002	Genetics- biology
						F049-GB003	Genetics- biology
F050	Location 2	72.524176	1.494909	1057	Amphipoda from F024; EtOH	F050-PB001	Preservation- biology

F051	Location 2	72.524160	1.495047	1059	Pycnogonid from F038; EtOH	F051-PB001	Preservation-biology
F052	Location 2	72.523941	1.494938	1077	Schaudinia / Trychasterina; subsamples in EtOH and -80°C; bulk split between EtOH and -80°C	F052-PB001	Preservation-biology
						F052-PB002	Preservation-biology
						F052-GB001	Genetics- biology
						F052-GB002	Genetics- biology
F053	Location 2				Sample lost	-	-
F054	Location 2	72.523776	1.494639	1084	Demosponge; subsample in EtOH, -80°C half specimen, remains in EtOH	F054-PB001	Preservation-biology
						F054-GB001	Genetics- biology
						F054-GB002	Genetics- biology
F055	Location 2	72.523776	1.494639	1084	Demosponge; subsample in EtOH, -80°C half specimen, remains in EtOH	F055-PB001	Preservation-biology
						F055-GB001	Genetics- biology
						F055-GB002	Genetics- biology
F056	Location 2	72.523776	1.494639	1084	Demosponge; subsample in EtOH, -80°C half specimen, remains in EtOH	F056-PB001	Preservation-biology
						F056-GB001	Genetics- biology
						F056-GB002	Genetics- biology
F057	Location 2	72.523776	1.494639	1084	Demosponge; subsample in EtOH, -80°C half specimen, remains in EtOH	F057-PB001	Preservation-biology
						F057-GB001	Genetics- biology
						F057-GB002	Genetics- biology
F058	Location 2	72.523780	1.494567	1083	Pycnogonida (seaspider)	F058-PB001	Preservation-biology
F059	Location 2	72.523780	1.494567	1083	Schaudinia / Trychasterina; subsamples in EtOH and -80°C; bulk in EtOH	F059-PB001	Preservation-biology
						F059-GB001	Genetics- biology
						F059-GB002	Genetics- biology
F060		72.523912	1.494599	1078	Starfish; arm tip x1 EtOH; remains in EtOH	F060-PB001	Preservation-biology
						F060-GB001	Genetics- biology

F061		72.523912	1.494599	1078	Gastropod; EtOH	F061-PB001	Preservation-biology
F062		72.523912	1.494599	1078	Gastropod; EtOH	F062-PB001	Preservation-biology
F063					Sample lost from ROV in transit to surface.	-	-
F064					Sample lost from ROV in transit to surface.	-	-
F065					Sample lost from ROV in transit to surface.	-	-
F066					Sample lost from ROV in transit to surface.	-	-
F067		72.523959	1.494517	1076	Soft coral: whole specimen in EtOH	F067-PB001	Preservation-biology
F068		72.524114	1.495037	1078	Tubeworms x3; EtOH	F068-PB001	Preservation-biology
F069		72.524119	1.494896	1077	Starfish; arm tip x1 EtOH; remains in EtOH	F069-PB001	Preservation-biology
						F069-GB001	Genetics- biology
F070		72.524064	1.495158	1079	Schaudinia / Trychasterina; subsamples in EtOH and -80°C; bulk at -80°C	F070-PB001	Preservation-biology
						F070-GB001	Genetics- biology
						F070-GB002	Genetics- biology
F071		72.524050	1.495140	1080	Schaudinia / Trychasterina; subsamples in EtOH and -80°C; bulk in EtOH	F071-PB001	Preservation-biology
						F071-GB001	Genetics- biology
						F071-GB002	Genetics- biology
F072		72.524050	1.495140	1080	Pisces (Eelpout); muscle sample in EtOH; remainder at -80°C	F072-PB001	Preservation-biology
						F072-GB001	Genetics- biology
LM001		72.530881	1.488499	1064	Species unknown	LM001-PB001	Preservation-biology
R001		72,52128038	1,47198419	1150	Soft coral picked from rock	R001-PB001	Preservation-biology
R003		72,52193264	1,48344690	988	Soft coral picked from rock	R003-PB001	Preservation-biology
R005		72,52194478	1,48741449	1014	Polychaete picked from rock	R005-PB001	Preservation-biology
					Polychaete picked from rock	R005-PB002	Preservation-biology
R016		72.524708	1.492883	1096	Granular tube polychaete	R016-PB001	Preservation-biology
					Granular tube polychaete	R016-PB002	Preservation-biology
R019		72.524144	1.493569	1061	Species unknown	R019-PB001	Preservation-biology
					Species unknown	R019-PB002	Preservation-biology

					Species unknown	R019-PB003	Preservation-biology
					Species unknown	R019-PB004	Preservation-biology
					Species unknown	R019-PB005	Preservation-biology
					Species unknown	R019-PB006	Preservation-biology
					Amphipods	R019-PB007	Preservation-biology
					Species unknown	R019-PB008	Preservation-biology
					Species unknown	R019-PB009	Preservation-biology
					Species unknown	R019-PB010	Preservation-biology
					Species unknown	R019-PB011	Preservation-biology
					Species unknown	R019-PB012	Preservation-biology
					Cladorhizids	R019-PB013	Preservation-biology
					Soft corals	R019-PB014	Preservation-biology

6.2.2 Microbiology samples

Table 2: Overview of the microbiology samples collected from the sediment cores from the expedition. From each sediment core sample, the top 2 cm was sampled for macroanalyses. The samples are to be analyzed by Norce.

Sample ID	Location	Latitude	Longitude	Depth	Downcore (cm)	Data	Data Type	Comments
SC001	Location 2	72.524186	1.494423	1072	0-2	SC001-MS001	Macro - sediment	
					0-2	SC001-MS002	Macro - sediment	
SC002	Location 2	72.524054	1.493816	1079	0-2	SC002-MS001	Macro - sediment	
					0-2	SC002-MS002	Macro - sediment	
SC003	Location 2	72.524046	1.493824	1079	0-2	SC003-MS001	Macro - sediment	
					0-2	SC003-MS002	Macro - sediment	
SC004	Location 2	72.523997	1.494289	1077	0-2	SC004-MS001	Macro - sediment	
					0-2	SC004-MS002	Macro - sediment	
SC005	Location 2	72.523993	1.494281	1077	0-2	SC005-MS001	Macro - sediment	
					0-2	SC005-MS002	Macro - sediment	
SC006	Location 2	72.523997	1.494274	1077	0-2	SC006-MS001	Macro - sediment	
					0-2	SC006-MS002	Macro - sediment	
SC007	Location 4	72.496473	1.521619	1737	-	-	-	No recovery
SC008	Location 4	72.496478	1.521581	1737	-	-	-	No recovery
SC009	Location 4	72.496463	1.521582	1737	0-2	SC009-MS001	Macro - sediment	
					0-2	SC009-MS002	Macro - sediment	
SC010	Location 4	72.496181	1.521830	1738	0-2	SC010-MS001	Macro - sediment	
					0-2	SC010-MS002	Macro - sediment	
SC011	Location 4	72.496181	1.521793	1738	0-2	SC011-MS001	Macro - sediment	
					0-2	SC011-MS002	Macro - sediment	
SC012	Location 4	72.496181	1.521793	1738	0-2	SC012-MS001	Macro - sediment	
					0-2	SC012-MS002	Macro - sediment	
SC013	Location 2	72.524088	1.494454	1052	-	-	-	No recovery
SC014	Location 2	72.524079	1.494406	1052	-	-	-	No recovery
SC015	Location 2	72.524096	1.494382	1052	-	-	-	No recovery
SC016	Location 2	72.524112	1.493921	1055	0-2	SC016-MS001	Macro - sediment	

					0-2	SC016-MS002	Macro - sediment	
SC017	Location 2	72.524431	1.493729	1062	0-2	SC017-MS001	Macro - sediment	
					0-2	SC017-MS002	Macro - sediment	
SC018	Location 2	72.524786	1.492553	1109	0-2	SC018-MS001	Macro - sediment	
					0-2	SC018-MS002	Macro - sediment	
SC019	Location 2	72.524009	1.491917	1136	-	-	-	No recovery
SC020	Location 2	72.525136	1.491217	1140	-	-	-	No recovery
SC021	Location 2	72.525411	1.490216	1138	0-2	SC021-MS001	Macro - sediment	
					0-2	SC021-MS002	Macro - sediment	
SC022	Location 2	72.525629	1.489303	1127	-	-	-	No recovery
SC023	Location 2	72.52588	1.488557	1129	0-2	SC023-MS001	Macro - sediment	
					0-2	SC023-MS002	Macro - sediment	
SC024	Location 2	72.526333	1.486894	1113	0-2	SC024-MS001	Macro - sediment	
					0-2	SC024-MS002	Macro - sediment	
SC025	Location 2	72.52435	1.494042	1075	0-2	SC025-MS001	Macro - sediment	
					0-2	SC025-MS002	Macro - sediment	
SC026	Location 2	72.52434722	1.493992	1074	0-2	SC026-MS001	Macro - sediment	
					0-2	SC026-MS002	Macro - sediment	
SC027	Location 2	72.52434167	1.493994	1087	0-2	SC027-MS001	Macro - sediment	
					0-2	SC027-MS002	Macro - sediment	
SC028	Location 2	72.52434722	1.493978	1085	0-2	SC028-MS001	Macro - sediment	
					0-2	SC028-MS002	Macro - sediment	
SC029	Location 2	72.52433889	1.493981	1102	-	-	-	No recovery
SC030	Location 2	72.52435278	1.493994	1102	0-2	SC030-MS001	Macro - sediment	
					0-2	SC030-MS002	Macro - sediment	
SC031	Location 2	72.52421389	1.493989	1087	0-2	SC031-MS001	Macro - sediment	
					0-2	SC031-MS002	Macro - sediment	
SC032	Location 2	75.52421111	1.494000	1087	-	-	-	No recovery
SC033	Location 2	72.52421389	1.494000	1087	0-2	SC033-MS001	Macro - sediment	
					0-2	SC033-MS002	Macro - sediment	

SC034	Location 2	72.52421111	1.494003	1089	0-2	SC034-MS001	Macro - sediment	
					0-2	SC034-MS002	Macro - sediment	
SC035	Location 2	72.52421944	1.493989	1089	0-2	SC035-MS001	Macro - sediment	
					0-2	SC035-MS002	Macro - sediment	
SC036	Location 2	72.52421667	1.493992	1090	0-2	SC036-MS001	Macro - sediment	
					0-2	SC036-MS002	Macro - sediment	
SC037	Location 2	72.523878	1.495583	1086	0-2	SC037-MS001	Macro - sediment	
					0-2	SC037-MS002	Macro - sediment	
SC038	Location 2	72.523889	1.495554	1086	-	-	-	No recovery
SC039	Location 2	72.523904	1.495554	1086	0-2	SC039-MS001	Macro - sediment	
					0-2	SC039-MS002	Macro - sediment	
					10-12	SC039-MS003	Macro - sediment	
SC040	Location 2	72.524265	1.495056	1080	0-2	SC040-MS001	Macro - sediment	
					0-2	SC040-MS002	Macro - sediment	
SC041	Location 2	72.524268	1.495070	1081	0-2	SC041-MS001	Macro - sediment	
					0-2	SC041-MS002	Macro - sediment	
SC042	Location 2	72.524281	1.494950	1080	-	-	-	No recovery
SC043	Location 2	72.515417	1.486246	1142	-	-	-	No recovery
SC044	Location 2	72.515412	1.486264	1142	-	-	-	No recovery
SC045	Location 2	72.515412	1.486264	1142	0-2	SC045-MS001	Macro - sediment	
					0-2	SC045-MS002	Macro - sediment	
SC046	Location 2	72.515369	1.487912	1142	0-2	SC046-MS001	Macro - sediment	
					0-2	SC046-MS002	Macro - sediment	
SC047	Location 2	72.515386	1.487966	1142	-	-	-	No recovery
SC048	Location 2	72.515401	1.488057	1142	0-2	SC048-MS001	Macro - sediment	
					0-2	SC048-MS002	Macro - sediment	

6.2.3 Microbiological samples

Table 3: Overview of the microbiological samples sample from push cores during the expedition. For each core, the top 2 cm of the sample was sampled for genetic purposes. For each third core, every 5 cm downcore was sampled for the same purpose. An overview of where in the core each sample is from, is given in the 'Downcore (cm)' column.

Sample ID	Location	Latitude	Longitude	Depth	Downcore (cm)	Data	Data Type	Comments
SC001	Location 2	72.524186	1.494423	1072	-	-	-	No microbiology
SC002	Location 2	72.524054	1.493816	1079	0-2	SC002-GS001	Genetics - sediment	
SC003	Location 2	72.524046	1.493824	1079	0-2	SC003-GS001	Genetics - sediment	
					6-7	SC003-GS002	Genetics - sediment	
					11-12	SC003-GS003	Genetics - sediment	
SC004	Location 2	72.523997	1.494289	1077	-	-	-	No microbiology
SC005	Location 2	72.523993	1.494281	1077	0-2	SC005-GS001	Genetics - sediment	
SC006	Location 2	72.523997	1.494274	1077	0-2	SC006-GS001	Genetics - sediment	
					6-7	SC006-GS002	Genetics - sediment	
					10-12	SC006-GS003	Genetics - sediment	
					15-17	SC006-GS004	Genetics - sediment	
					20-22	SC006-GS005	Genetics - sediment	
					25-27	SC006-GS006	Genetics - sediment	
SC007	Location 4	72.496473	1.521619	1737	-	-	-	No recovery
SC008	Location 4	72.496478	1.521581	1737	-	-	-	No recovery
SC009	Location 4	72.496463	1.521582	1737	0-2	SC009-GS001	Genetics - sediment	
					5-7	SC009-GS002	Genetics - sediment	
					10-12	SC009-GS003	Genetics - sediment	
					15-17	SC009-GS004	Genetics - sediment	
					21-22	SC009-GS005	Genetics - sediment	
SC010	Location 4	72.496181	1.521830	1738	-	-	-	No microbiology
SC011	Location 4	72.496181	1.521793	1738	0-2	SC011-GS001	Genetics - sediment	
SC012	Location 4	72.496181	1.521793	1738	0-2	SC012-GS001	Genetics - sediment	
					5-7	SC012-GS002	Genetics - sediment	
					10-11	SC012-GS003	Genetics - sediment	

					15-16	SC012-GS004	Genetics - sediment	
					20-21	SC012-GS005	Genetics - sediment	
SC013	Location 2	72.524088	1.494454	1052	-	-	-	No recovery
SC014	Location 2	72.524079	1.494406	1052	-	-	-	No recovery
SC015	Location 2	72.524096	1.494382	1052	-	-	-	No recovery
SC016	Location 2	72.524112	1.493921	1055	0-2	SC016-GS001	Genetics - sediment	
					5-7	SC016-GS002	Genetics - sediment	
					10-12	SC016-GS003	Genetics - sediment	
					15-17	SC016-GS004	Genetics - sediment	
					20-22	SC016-GS005	Genetics - sediment	
SC017	Location 2	72.524431	1.493729	1062	0-2	SC017-GS001	Genetics - sediment	
					5-7	SC017-GS002	Genetics - sediment	
					10-12	SC017-GS003	Genetics - sediment	
					15-17	SC017-GS004	Genetics - sediment	
					20-22	SC017-GS005	Genetics - sediment	
SC018	Location 2	72.524786	1.492553	1109	0-2	SC018-GS001	Genetics - sediment	
					5-7	SC018-GS002	Genetics - sediment	
					10-12	SC018-GS003	Genetics - sediment	
SC019	Location 2	72.524009	1.491917	1136	-	-	-	No recovery
SC020	Location 2	72.525136	1.491217	1140	-	-	-	No recovery
SC021	Location 2	72.525411	1.490216	1138	0-2	SC021-GS001	Genetics - sediment	
					5-7	SC021-GS002	Genetics - sediment	
					10-12	SC021-GS003	Genetics - sediment	
					15-17	SC021-GS004	Genetics - sediment	
					20-22	SC021-GS005	Genetics - sediment	
SC022	Location 2	72.525629	1.489303	1127	-	-	-	No recovery
SC023	Location 2	72.52588	1.488557	1129	0-2	SC023-GS001	Genetics - sediment	
					5-7	SC023-GS002	Genetics - sediment	
					10-12	SC023-GS003	Genetics - sediment	
					15-17	SC023-GS004	Genetics - sediment	

					20-22	SC023-GS005	Genetics - sediment	
SC024	Location 2	72.526333	1.486894	1113	0-2	SC024-GS001	Genetics - sediment	
					5-7	SC024-GS002	Genetics - sediment	
					10-12	SC024-GS003	Genetics - sediment	
					15-17	SC024-GS004	Genetics - sediment	
					20-22	SC024-GS005	Genetics - sediment	
SC025	Location 2	72.52435	1.494042	1075	0-2	SC025-GS001	Genetics - sediment	
					5-7	SC025-GS002	Genetics - sediment	
					10-12	SC025-GS003	Genetics - sediment	
SC026	Location 2	72.524347 22	1.493992	1074	0-2	SC026-GS001	Genetics - sediment	
SC027	Location 2	72.524341 67	1.493994	1087	0-2	SC027-GS001	Genetics - sediment	
SC028	Location 2	72.524347 22	1.493978	1085	0-2	SC028-GS001	Genetics - sediment	
					5-7	SC028-GS002	Genetics - sediment	
SC029	Location 2	72.524338 89	1.493981	1102	-	-	-	No recovery
SC030	Location 2	72.524352 78	1.493994	1102	0-2	SC030-GS001	Genetics - sediment	
					5-7	SC030-GS002	Genetics - sediment	
					10-12	SC030-GS003	Genetics - sediment	
					15-17	SC030-GS004	Genetics - sediment	
SC031	Location 2	72.524213 89	1.493989	1087	-	-	-	No microbiology
SC032	Location 2	75.524211 11	1.494000	1087	-	-	-	No recovery
SC033	Location 2	72.524213 89	1.494000	1087	0-2	SC033-GS001	Genetics - sediment	
					5-7	SC033-GS002	Genetics - sediment	
					10-12	SC033-GS003	Genetics - sediment	
					15-17	SC033-GS004	Genetics - sediment	
					20-22	SC033-GS005	Genetics - sediment	
					25-27	SC033-GS006	Genetics - sediment	
SC034	Location 2	72.524211 11	1.494003	1089	0-2	SC034-MS001	Macro - sediment	No microbiology
SC035	Location 2	72.524219 44	1.493989	1089	0-2	SC035-GS001	Genetics - sediment	

SC036	Location 2	72.524216 67	1.493992	1090	0-2	SC036- GS001	Genetics - sediment	
					5-7	SC036- GS002	Genetics - sediment	
					10-12	SC036- GS003	Genetics - sediment	
					15-17	SC036- GS004	Genetics - sediment	
SC037	Location 2	72.523878	1.495583	1086	-	-	-	No microbiology
SC038	Location 2	72.523889	1.495554	1086	-	-	-	No recovery
SC039	Location 2	72.523904	1.495554	1086	0-2	SC039- GS001	Genetics - sediment	
					5-7	SC039- GS002	Genetics - sediment	
					10-12	SC039- GS003	Genetics - sediment	
					15-17	SC039- GS004	Genetics - sediment	
					20-22	SC039- GS005	Genetics - sediment	
					25-27	SC039- GS006	Genetics - sediment	
SC040	Location 2	72.524265	1.495056	1080				No microbiology
SC041	Location 2	72.524268	1.495070	1081	0-2	SC041- GS001	Genetics - sediment	
					5-7	SC041- GS002	Genetics - sediment	
					10-12	SC041- GS003	Genetics - sediment	
					15-17	SC041- GS004	Genetics - sediment	
SC042	Location 2	72.524281	1.494950	1080	-	-	-	No recovery
SC043	Location 2	72.515417	1.486246	1142	-	-	-	No recovery
SC044	Location 2	72.515412	1.486264	1142	-	-	-	No recovery
SC045	Location 2	72.515412	1.486264	1142	0-2	SC045- GS001	Genetics - sediment	
					5-7	SC045- GS002	Genetics - sediment	
					10-12	SC045- GS003	Genetics - sediment	
SC046	Location 2	72.515369	1.487912	1142				No microbiology
SC047	Location 2	72.515386	1.487966	1142	-	-	-	No recovery
SC048	Location 2	72.515401	1.488057	1142	0-2	SC048- GS001	Genetics - sediment	
					5-7	SC048- GS002	Genetics - sediment	
					10-12	SC048- GS003	Genetics - sediment	
					15-17	SC048- GS004	Genetics - sediment	

6.2.4 Rock core samples

Table 4: Overview of the rock cores sampled during the DI23 expedition.

Sample ID	Location	Core Site	Excavator dive	Latitude	Longitude	Depth	Depth interval	Weight (kg)	Description
RC001	Location 2	1	Dive 004	72.524255	1.494561	1056	0-1.5	1.3	Recovery rate: 52%, 78 cm
RC002	Location 2	1	Dive 004	72.524255	1.494561	1056	1.5-3	<1	Recovery rate: 27%, 41 cm
RC003	Location 2	1	Dive 004	72.524255	1.494561	1056	3-4.5	1.4	Recovery rate: 25%, 38 cm
RC004	Location 2	1	Dive 004	72.524255	1.494561	1056	4.5-6	2.4	Recovery rate 41%, 62 cm
RC005	Location 2	2	Dive 005	72.524160	1.494534	1068	0-3	<1	Recovery rate: 6%, 19 cm
RC006	Location 2	3	Dive 006	72.524145	1.49473	1071	0-3	-	Recovery rate: 0%, 0 cm
RC007	Location 2	3	Dive 006	72.524145	1.49473	1071	no core to recover	-	Recovery rate: 0%, 0 cm
RC008	Location 2	3	Dive 006	72.524145	1.49473	1071	3.0-6.0	1	Recovery rate: 10%, 31 cm
RC009	Location 2	3	Dive 006	72.524145	1.49473	1071	6.0-9.0	3.6	Recovery rate: 31%, 93 cm
RC010	Location 2	3	Dive 006	72.524145	1.49473	1071	9.0-12.0	1.5	Recovery rate: 6%, 19 cm
RC011	Location 2	3	Dive 006	72.524145	1.49473	1071	Lost in bore hole	-	Recovery rate: 0%, 0 cm

6.2.5 Rock samples

Table 5: Overview of the rock samples from the DI23 expedition. A preliminary categorization of the rocks is provided in the column 'category'.

Sample ID	Latitude	Longitude	Depth	Category
R001	72.5212804	1.47198419	1150	Altered Basalt
R002	72.5230421	1.48311494	1042	Dropstone
R003	72.5219326	1.4834469	988	Dropstone
R004	72.5219448	1.48741449	1014	Not recovered
R005	72.5219448	1.48741449	1014	Sediment
R006	72.5241799	1.49483705	1075	Mn-Crust
R007	72.5241626	1.49492802	1077	Fe-oxide
R008	72.5241736	1.4975831	1073	Fe-oxide
R009	72.5241422	1.49460145	1072	Fe-oxide
R010	72.5263855	1.48647514	1113	Dropstone
R011	72.524256	1.494265	1057	Fe-oxide
R012	72.52422	1.49421	1054	Fe-oxide
R013	72.524137	1.494753	1057	Fe-oxide
R014	72.52473	1.492729	1095	Fe-oxide
R015	72.524652	1.492822	1096	Fe-oxide
R016	72.524708	1.492907	1095	Fe-oxide
R017	72.524588	1.492899	1093	Dropstone
R018	72.524561	1.492968	1091	Fe-oxide
R019	72.524145	1.49352	1061	Fe-oxide
R020	72.52549	1.499596	1202	Basalt
R021	72.525484	1.499345	1191	Basalt
R022	72.525343	1.498874	1178	Fe-oxide
R023	72.524392	1.495381	1080	Fe-oxide
R024	72.525544	1.494552	1149	Fe-oxide
R025	72.523011	1.501505	1175	Altered Basalt
R026	72.5242	1.4943	1065	Fe-oxide
R027	72.530929	1.463754	1365	Altered Basalt
R028	72.528319	1.470191	1090	Altered Basalt
R029	72.530165	1.483783	1063	Basalt
R030	72.531131	1.489482	1056	Dropstone
R031	72.532414	1.496797	1082	Dropstone
R032	72.532521	1.500454	1094	Altered Basalt
R033	72.524216	1.494224	1052	Fe-oxide
R034	72.524631	1.493419	1078	Fe-oxide
R035	72.524854	1.494388	1077	Fe-oxide
R036	72.526131	1.497592	1187	Fe-oxide
R037	72.526184	1.497966	1194	Fe-oxide
R038	72.524637	1.493664	1076	Fe-oxide (bulk)