Upstream Pathways of the Faroe Overflow (UFO) Cruise Report

F2024-012-AR84-03AB

Photo by Croy Carlin

Cruise Summary

Vessel: R/V *Neil Armstrong*

Cruise ID: AR84-03

Ports of call: Reykjavík, Iceland – Tórshavn, Faroe Islands – Reykjavík, Iceland

Dates: August 19 – September 26, 2024

Chief Scientist: Robert Pickart, Woods Hole Oceanographic Institution

A: Overview & Objectives

A1: Overview

The overflow of dense water across the Greenland-Scotland Ridge, and its subsequent entrainment, is a fundamental component of the Atlantic Meridional Overturning Circulation (AMOC) which helps maintain Earth's climate. It is critically important to determine the mechanisms, forcing, and variability of the AMOC. The project entitled "Upstream Pathways of the Faroe Overflow" (UFO) is multi-institutional, interdisciplinary effort to study the origin and pathways of the dense water that feeds the Faroe Bank Channel overflow. This overflow is the densest component of the AMOC and accounts for a significant portion of the composite overflow across the Greenland-Scotland Ridge. The UFO program includes a mooring array, gliders, hydrographic surveys, and modeling. Together, this will help determine where the densest water is formed in the Nordic Seas, how this water progresses to the Greenland-Scotland Ridge, and how it is modified along the way including the role of atmospheric forcing. This in turn will provide a better understanding of the means by which the warming climate may impact the AMOC. The different institutions participating in UFO are the Woods Hole Oceanographic Institution (WHOI), the Faroe Marine Research Institute (FAMRI), the University of Bergen (UIB) Norway, NORCE research Institute, and the Marine and Freshwater Research Institute of Iceland (MFRI).

This report summarizes operations carried out aboard the R/V *Neil Armstrong* during AR84-03 in August-September 2024 as part of the first stage of UFO. In addition to AR84-03, there were two other cruises contributing to UFO that took place during the same time frame: JS-2436 on the R/V *Jákup Sverri* (FAMRI) and B12-2024 on the R/V *Bjarni Sæmundsson* (MFRI).

AR84-03 Scientific Objectives

The primary objectives of the *Armstrong* cruise were as follows:

(1) To deploy 9 moorings across the northern flank of the Iceland-Faroe Ridge to measure the two branches of the Iceland-Faroe Slope Jet (IFSJ) as well as the rim of the Norwegian Sea Gyre (the 10^{th} mooring of the UFO array was deployed by FAMRI).

(2) To carry out a broad hydrographic/velocity/tracer survey upstream of the array, extending as far northward as the Greenland Sea.

(3) To provide a platform for ancillary measurements that are complimentary to UFO.

Table A1: AR84-03 Science Party, Leg 1.

Surname	Name	Affiliated Institution	Role
Pickart	Robert	Woods Hole Oceanographic Institution	Chief Scientist
Kemp	John	Woods Hole Oceanographic Institution	Technician
Hogue	Brian	Woods Hole Oceanographic Institution	Technician
Hutt	Eric	Woods Hole Oceanographic Institution	Technician
Brakstad	Ailin	University of Bergen	Technician
Våge	Kjetil	University of Bergen	Scientist
Huang	Jie	Woods Hole Oceanographic Institution	Postdoc
Semper	Stefanie	University of Bergen	Scientist
Gutiérrez García	Marina	University of Las Palmas de Gran Canaria	Graduate student
Bonilla Pagan	Joan	Johns Hopkins University	Graduate student
Wang	Yanxin	Shanghai Jiao Tong University	Postdoc
Houghton	Leah	Woods Hole Oceanographic Institution	Technician
Jeansson	Emil	NORCE	Scientist
Löhr	Jannik	NORCE	Intern
Dale	Duncan	Swiss Federal Institute of Technology	Graduate student
Chanatry	Hannah	Freelance Media	Outreach

Table A2: AR84-03 Science Party, Leg 2.

Surname	Name	Affiliated Institution	Role
Pickart	Robert	Woods Hole Oceanographic Institution	Chief Scientist
Huang	Jie	Woods Hole Oceanographic Institution	Postdoc
Semper	Stefanie	University of Bergen	Scientist
Gutiérrez García	Marina	University of Las Palmas de Gran Canaria	Graduate student
Bonilla Pagan	Joan	Johns Hopkins University	Graduate student
Wang	Yanxin	Shanghai Jiao Tong University	Postdoc
Pimm	Ciara	Woods Hole Oceanographic Institution	Postdoc
Bahr	Frank	Woods Hole Oceanographic Institution	Technician
Houghton	Leah	Woods Hole Oceanographic Institution	Technician
Jeansson	Emil	NORCE	Scientist
Jackson-Misje	Kristin	University of Bergen	Technician
Löhr	Jannik	NORCE	Intern
Dale	Duncan	Swiss Federal Institute of Technology	Graduate student
Schnepper	Charlotte	Swiss Federal Institute of Technology	Graduate student
Chanatry	Hannah	Freelance Media	Outreach

A2: Cruise Narrative

Leg 1 departed Reykjavík on 19 August with the primary aim of deploying the mooring array. Before mooring operations began, we did a test cast of the conductivity-temperature-depth (CTD) system, which also served as a calibration cast for the MicroCATs to be used on the moorings. A separate cast was done to test some of the acoustic releases (further release testing and MicroCAT calibrations were done later). All 9 moorings were successfully deployed over a period of five days, and a CTD section was occupied along the mooring line. Much of the CTD work was done during the overnight hours. Minimal tracer work was done on leg 1, which was mainly used for setting up and testing the instrumentation. Leg 1 finished on 27 August in Tórshavn.

Leg 2 departed Tórshavn on 28 August. We first went to the mooring line and did a calibration CTD cast at each mooring site. Following this, the large-scale hydrographic survey was carried out. This consisted of 10 transects. Typical station spacing was 10 km, and most casts were taken to the bottom. The main exception to this was the northern-most transect that extended into the Greenland Sea Gyre. After sampling the East Greenland Current (at high resolution) only three sparsely-spaced stations were done in the gyre (only one of them reaching the bottom). Roughly halfway through the survey we experienced a major storm that required sheltering in the lee of Jan Mayen Island for nearly four days. Because of this, and other periods of high winds, the survey needed to be scaled down. Nonetheless, we successfully sampled the regions of highest priority for the UFO objectives. Throughout the survey, underway measurements were made using *Armstrong's* shipboard acoustic Doppler current profilers (ADCPs), thermosalinograph (TSG), and met sensors. Tracer measurements were made at select stations and depths during each of the transects. The CTD survey was completed on 23 September, and we arrived in Reykjavík on 26 September.

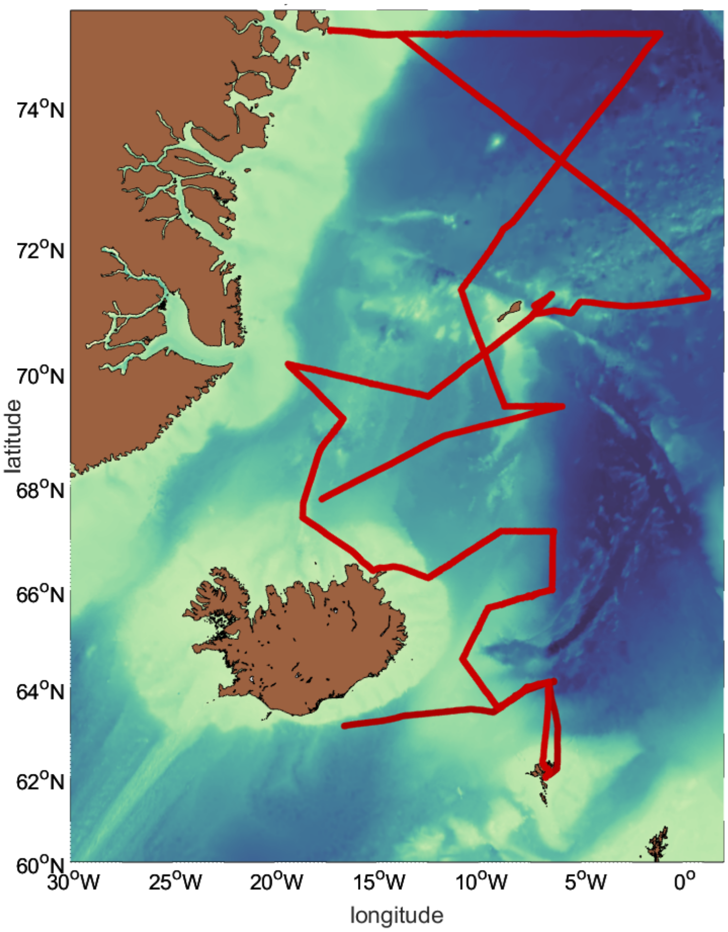


Figure A1: Cruise track of AR84-03.

A timeline of all cruise activities is archived in the Event Log found in Appendix A.

B: Mooring Operations

Nine tall moorings were deployed on leg 1: eight WHOI moorings and the UIB mooring (the FAMRI mooring was deployed on the *Jákup Sverri* cruise). Table B1 gives the pertinent information for the full mooring array, and Fig. B1 shows the location of the moorings. The WHOI moorings have their top floats at 100 m in order to sample the lower part of the Faroe Current. While scientifically advantageous, this represents a risk due to the fishing activity in the region. In order to help mitigate this risk, we hired the company Fishfacts (https://www.fishfacts.com/) to communicate the location of the array to the Faroese fishing fleet. The UIB top float is at 200 m, and the FAMRI top float is at 800 m.

All moorings were deployed anchor-last using a Lebus double-capstan winch system; the WHOI moorings were acoustically surveyed immediately after deployment. The "As-deployed" mooring diagrams for the WHOI and UIB moorings are contained in Appendix B. A view of the mooring array in the vertical plane is shown below in Fig. C2. Details on the UIB mooring are contained in Section J below.

Table B1: UFO Deployed mooring positions.

WHOI Moorings						
Name	**Latitude**	**Longitude**	**Bottom depth**	**Date**	**Anchor Drop Time**	**Position Method**
UFO1	63 36.18	08 51.10	643	21-Aug	14:26	surveyed position
UFO2	63 39.69	08 39.82	720	22-Aug	10:38	surveyed position
UFO3	63 43.11	08 28.87	805	23-Aug	09:44	surveyed position
UFO4	63 46.47	08 17.89	930	23-Aug	15:06	surveyed position
UFO5	63 50.04	08 06.47	1084	24-Aug	09:54	surveyed position
UFO6	63 53.37	07 55.40	1236	24-Aug	15:16	surveyed position
UFO7	63 56.72	07 44.87	1408	25-Aug	10:09	surveyed position
UFO8	63 59.98	07 33.88	1615	25-Aug	15:08	surveyed position
UIB Mooring						
Name	**Latitude**	**Longitude**	**Bottom depth**	**Date**	**Anchor Drop Time**	**Position Method**
UFO9	64 03.95	07 04.21	2417	26-Aug	15:35	Target
FAMRI Mooring						
Name	**Latitude**	**Longitude**	**Bottom depth**	**Date**	**Anchor Drop Time**	**Position Method**
UFO10	64 07.24	06 34.04	2789	30-Aug	03:34	Target

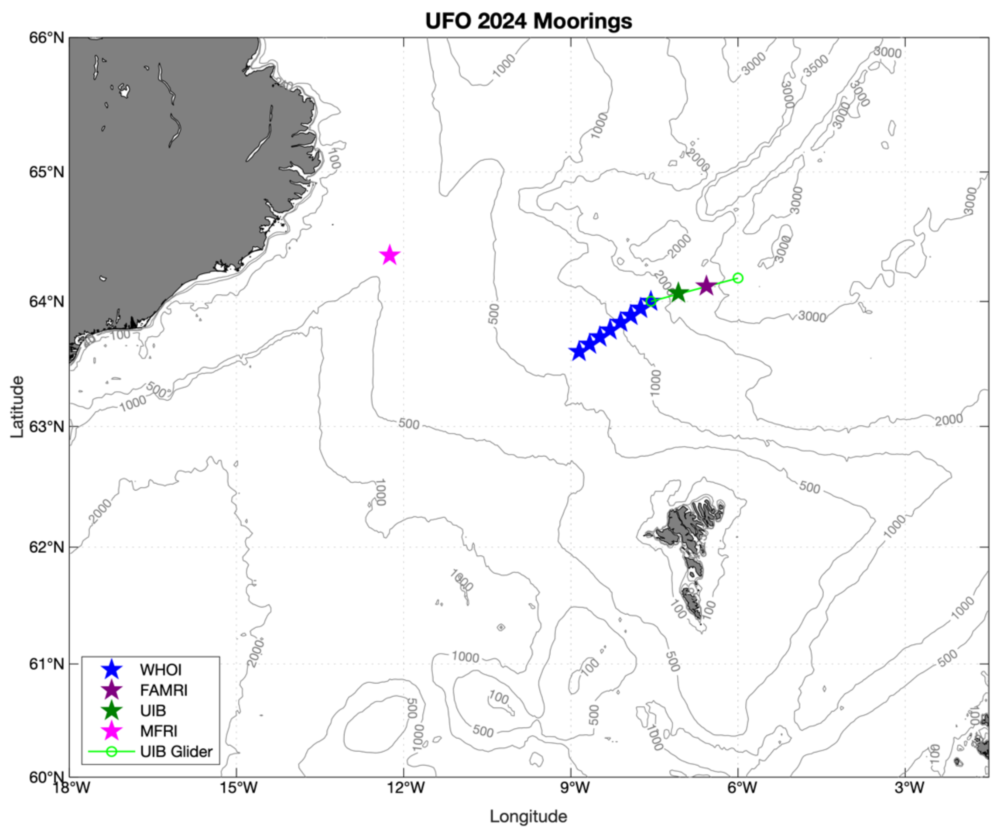


Figure B1: Locations of the UFO moorings (see the legend). Included on the map is the UIB glider track which will cover the offshore part of the mooring array (top 1000 m). Also included is the mooring deployed by MFRI to measure the Western Valley overflow.

C: CTD Operations

A total of 212 CTD casts were carried out on AR84-03 using a Sea-Bird 911plus CTD and deck unit configured to measure pressure, temperature (dual sensors), conductivity (dual sensors), dissolved oxygen, beam transmission, and chlorophyll fluorescence. The bottom approach was controlled by real time altimeter data together with the ship's multibeam data. Discrete water samples were collected using a rosette frame holding 24 10-L Niskin bottles. Calibrations of all CTD sensors were performed by the manufacturer before the start of the field season.

The CTD data were processed using Sea-Bird software. The raw CTD data were lag corrected, edited for large spikes, smoothed according to sensor, and pressure averaged into 2-db bins for final data quality control and analysis. Salinity and oxygen data were then further quality controlled and calibrated using Niskin water measurements. The overall CTD performance was excellent with the exception of a few biofouling events. A detailed outline of important events, problems encountered, and data processing can be found in the AR84-03_CTD_Calibration_Report.pdf document.

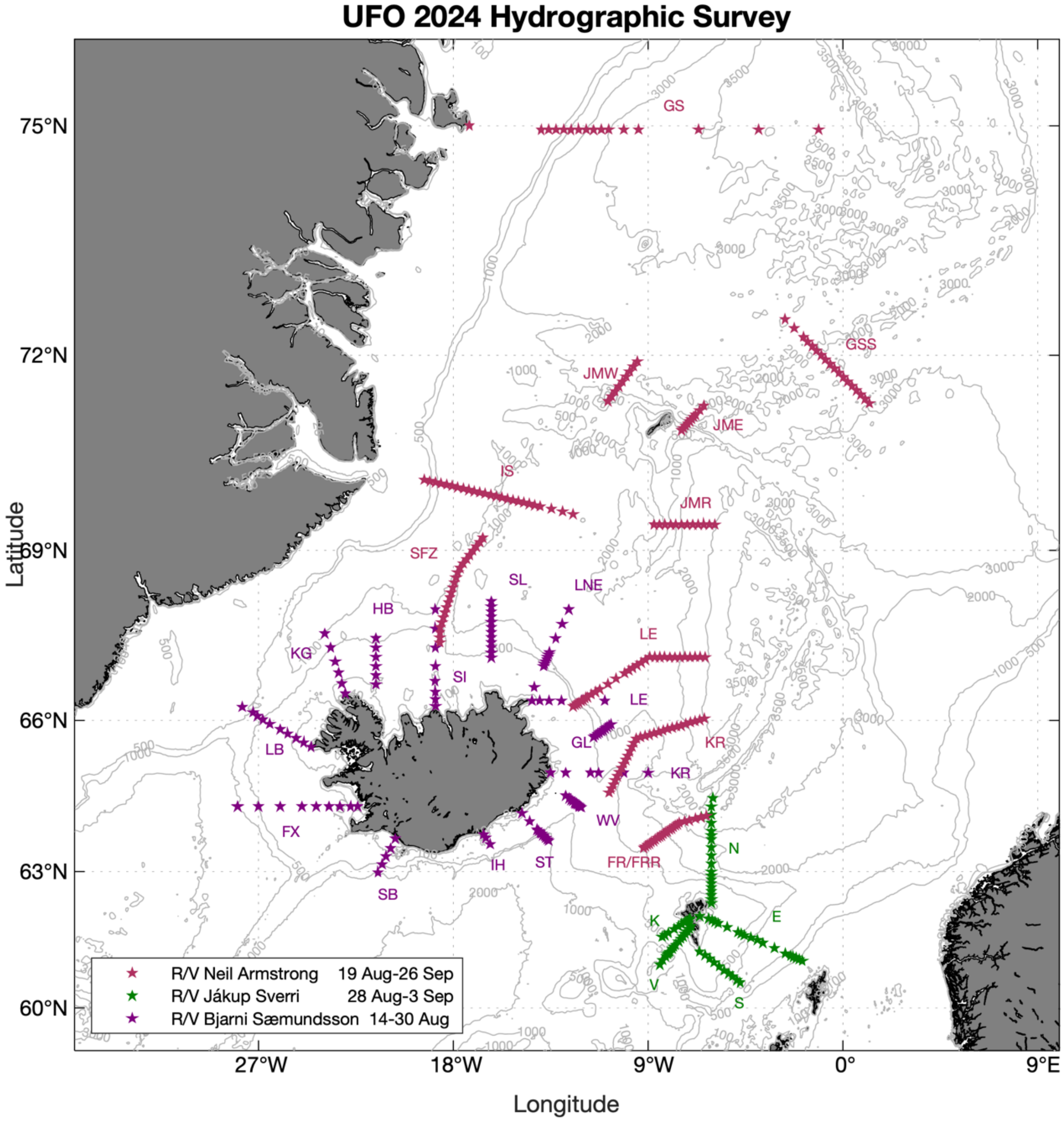


Figure C1: Three-ship UFO hydrographic survey carried out in Aug-Sep 2024 (see the legend). The AR84-03 survey extended from the Iceland-Faroe Ridge to the Greenland Sea. Transect abbreviations are listed in Table C1. The bottom topography is from ETOPO-2.

Ten transects were occupied on leg 2 of AR84-03 (Fig. C1). (The mooring transect, FR, was occupied on Leg 1.) Sampling from the Niskin bottles was done for a suite of tracers on select casts at select depths, as documented below. Shortly after the completion of each transect, vertical sections were constructed of potential temperature, practical salinity, potential density, and absolute geostrophic velocity. The latter was referenced using the shipboard ADCP data. This information helped guide the planning of future transects.

Table C1: Transect abbreviations for the three UFO hydrographic surveys (see Fig. C1).

AR84-03 Abbreviation	AR84-03 Transect Name
FR	Faroe Ridge
FRR	Faroe Ridge Repeat
KR	Krossanes
LE	Langanes East
SFZ	Spar Fracture Zone
IS	Iceland Sea
JMR	Jan Mayen Ridge
JME	Jan Mayen East
JMW	Jan Mayen West
GSS	Greenland Sea South
GS	Greenland Sea

JS2436 Abbreviation	JS2436 Transect Name
N	North
E	East
S	South
V	West
K	Koltur

B12-2024 Abbreviation	B12-2024 Transect Name
FX	Faxaflói
LB	Látrabjarg
KG	Kögur
HB	Hornbanki
SI	Siglunes
SL	Slétta
LNE	Langanes Northeast
LE	Langanes East
GL	Glettinganes
KR	Krossanes
WV	Western Valley
ST	Stokksnes
IH	Ingólfshöfði
SB	Selvogsbanki

D: Shipboard ADCP

Contributed by F. Bahr

Shipboard ADCP data were collected throughout the cruise using the Armstrong's three hull-mounted current profilers: a Teledyne RDI Workhorse 300 kHz, and two Ocean Surveyor ADCPs operating at 150 and 38 kHz, respectively.

Data were collected using UHDAS (University of Hawaii Data Acquisition System). The two Ocean Surveyors were configured for narrowband mode with vertical bin sizes of 16m (OS38) and 8m (OS150). The Workhorse 300 kHz ADCP was configured for a vertical bin size of 2 meters. All sonars collected 300-second profiles. Bottom tracking, typically used for calibration verifications, was disabled to collect more water track pings.

Data from all three ADCPs were processed throughout the cruise. The typical UHDAS post-processing steps were performed, which included manual editing out bad data. The calibration of the three sonar systems was verified via the water track method, leading to a small adjustment of the OS150's scale factor ("calibration amplitude") of 1.014. The averaged ensemble data were exported to MATLAB format for de-tiding and further analysis. Tidal corrections to the current data were made using the OSU tidal prediction software (OTPS) with the TPXO9-v5-atlas tidal model.

While all three ADCPs performed well, the data quality was reduced during portions of the cruise due to weather. Most ADCP installations show some "underway bias", a drift towards the direction of ship's motion, during rough weather. This was observed here particularly for the OS150 and the WH300. Curiously, poor weather conditions caused higher on-station data loss for the OS38. We speculate that enhanced ship's roll led to loss of signal returns.

References for UHDAS and OTPS:

Firing, E., J.M. Hummon, and T.K. Chereskin. 2012. Improving the quality and accessibility of current profile measurements in the Southern Ocean. Oceanography 25(3):164–165, https://doi.org/10.5670/oceanog.2012.91.

Egbert, Gary D., and Svetlana Y. Erofeeva. "Efficient inverse modeling of barotropic ocean tides." Journal of Atmospheric and Oceanic Technology 19.2 (2002): 183-204.

E: Salinometer operations

Contributed by L. Houghton

Salinity samples were continuously analyzed during the cruise using a WHOI-provided salinometer. A total of 862 salinity samples were collected in 200 ml glass bottles. The bottles were rinsed three times, then filled to the neck. After the samples reached the lab temperature of approximately 22°C, they were initially analyzed for salinity using a Guildline Autosal model 8400 B. Later in the cruise, the Autosal developed problems in the sample cell and was replaced with a Portasal model 8410 A. Accuracies of salinity measurements were ±0.002 psu when a good standardization was achieved. Bottle salinity values were then merged with CTD bottle files to be used in further calibrating the CTD's conductivity sensors.

F: Radionuclides

Contributed by D. Dale

Group: TITANICA – Physical and Tracer Oceanography
Institute of Biogeochemistry and Pollutant Dynamics - ETH Zurich, Switzerland

Contribution: Use of artificial and natural radionuclides as transient tracers to identify water mass mixing and transit pathways in the Nordic Seas with a focus on upstream sources to the Faroe overflow.

This component of the cruise relies on the measurement of the concentration of a suite of four radionuclides (radioactive isotopes) in seawater samples taken strategically from targeted locations throughout the sampling area. Each radionuclide has a defined spatial and temporal input to the study area and, taken together as a quasi-synoptic survey, the cruise should provide a unique opportunity to draw conclusions about the upstream pathways of the Faroe overflow and mixing between water masses in the upstream area of the Nordic Seas. The four radionuclides (with number of samples n taken) are:

Iodine-129 (^{129}I) (n=230): A fission product formed in nuclear reactors and released into the ocean from nuclear reprocessing plants (NRP) since the 1970s in the UK and France, forming a point-like source from the North Sea to high latitudes via the Norwegian Coastal Current. With only extremely small natural abundance and very minor global input from atmospheric bomb testing, this tracer is a powerful lateral tracer of circulation downstream of the Atlantic input to the Arctic domain.

Uranium-236 (^{236}U) (n=200): A product of neutron absorption by ^{235}U in nuclear reactors, this is a nuclear waste product also released by NRP, though with a different release history than ^{129}I. This radionuclide was also introduced to the surface oceans by atmospheric bomb tests in the 1950-1960s and so has potential as both a lateral and a vertical (ventilation) tracer. Combined with ^{129}I as a dual tracer, these two radionuclides can provide strong inferences about the origin and mixing of water masses in this region[1].

Dissolved inorganic ^{14}C (DI14C) (n=120): Radiocarbon (^{14}C), a radioactive isotope of carbon, is produced continuously in the atmosphere by cosmic ray and solar particle bombardment of the atmosphere before being taken up by the ocean surface in the form of dissolved CO_2, i.e. dissolved inorganic carbon (DIC). With a half-life of 5370 years, this ^{14}C-carrying DIC (i.e. DI14C) acts like a ticking clock enabling the estimation of time since any water mass was last in contact with the atmosphere. This is therefore primarily a vertical "ventilation" tracer.

Tritium (^{3}H) (n=50): An isotope of hydrogen with two additional neutrons, the tritium currently found in the oceans comes primarily from atmospheric hydrogen bomb tests in the 1950-60s but is also being released in considerable quantities by the La Hague NRP in France. This makes tritium a potential ventilation and lateral tracer depending on the sampled location. With a half-life of 12.3 years it represents a much faster "ticking clock" than DI14C.

Samples have been taken at strategic locations to best characterize all the water masses present in the study area so as to produce end-member values of each, identify their transit pathways through the area, and estimate their mixing proportions and contributions to the Faroe overflow. Attempt will also be made to use the transient nature of the tracers to estimate timescales of key pathways. The hydrographic data recorded during the cruise will be essential in categorizing and characterizing water masses.

Samples will be shipped to Switzerland and measurement carried out (following purification/enrichment) by Accelerator Mass Spectrometry at the Laboratory of Ion-beam Physics (LIP), ETH Zurich (^{129}I, ^{236}U and DI14C) and liquid scintillation counting (^{3}H) at the Swiss Federal Institute of Aquatic Science and Technology (EAWAG). A full final data set is expected in 6-9 months with publication to be submitted within one year.

1) Dale, Duncan, et al. "Tracing ocean circulation and mixing from the Arctic to the subpolar North Atlantic using the ^{129}I–^{236}U dual tracer." *Journal of Geophysical Research: Oceans* 129.7 (2024): e2024JC021211

G: Organic Carbon

Contributed by C. Schnepper

Isotopic and chemical characterization of dissolved organic matter in the Nordic Seas

Charlotte Schnepper & Margot E. White

Background. The dissolved organic carbon (DOC) reservoir is the largest store of reduced carbon in the ocean and of a similar size to the atmospheric CO_2 reservoir. It has been proposed that changes to the marine DOC reservoir are linked to major climate events in the geologic record, but it is unknown how this reservoir has changed in the past and how, and on what timescale, it is likely to change in the future. Radiocarbon (^{14}C) measurements show that on average the molecules that make up the marine DOC pool are several thousand years old, implying that they may have persisted in the ocean over the course of multiple mixing cycles of global overturning circulation. Different theories have been proposed to explain this persistence, each with very different implications for the potential response of this large reservoir of carbon to anthropogenic climate change.

Objectives and methods. The main objective of this project is to isolate the most persistent fraction of marine DOC and to compare the concentration and chemical and isotopic composition of this component across different water masses in the North Atlantic, where deep water formation functions as the "engine" driving the global overturning circulation of the oceans. I will isolate this component using chemical degradation followed by separation based on polarity using liquid chromatography. Resulting fractions will then be analyzed for ^{14}C and chemical composition using high resolution mass spectrometry to link turnover time with the chemical characteristics of these compounds. In addition to SPE fractions, I will measure the bulk ^{14}C signature of DOC using UV oxidation. These results will be interpreted in the context of water mass circulation information gained from the tracers employed by the Casacuberta Lab.

We have been sampling 10 Stations during the cruise, with two samples each depth. The newly formed water masses were targeted, which mostly appeared in the top 1000 meter and occasionally, as for the Greenland Sea, in the deep ocean. As these 5L samples undergo a processing of 2 days (Solid phase extraction) on the ship, the resulting resolution with a total 74 samples is very high.

Planned processing and publications. These samples will be analyzed over the coming year in the Biogeoscience group at ETH Zurich. M. White will continue to work on data interpretation and manuscript writing when she transitions to her new position as an assistant professor of chemical oceanography at the University of British Columbia in Vancouver, Canada starting in July 2025.

H: Transient Tracers

Contributed by E. Jeansson, K. Jackson-Misje, and J. Löhr

During the AR84-03 cruise we took samples for the transient tracers chlorofluorocarbon-12 (CFC-12) and sulphur hexafluoride (SF_6), dissolved oxygen, nutrients, and inorganic carbon, on a large part of the CTD stations. In total 83 stations have some of the variables (Figure H1). The transient tracers and oxygen were analyzed on board, while we took samples for nutrients for analyses by the lab in Iceland, and inorganic carbon to be analyzed in Bergen. More details on respective variables are given below.

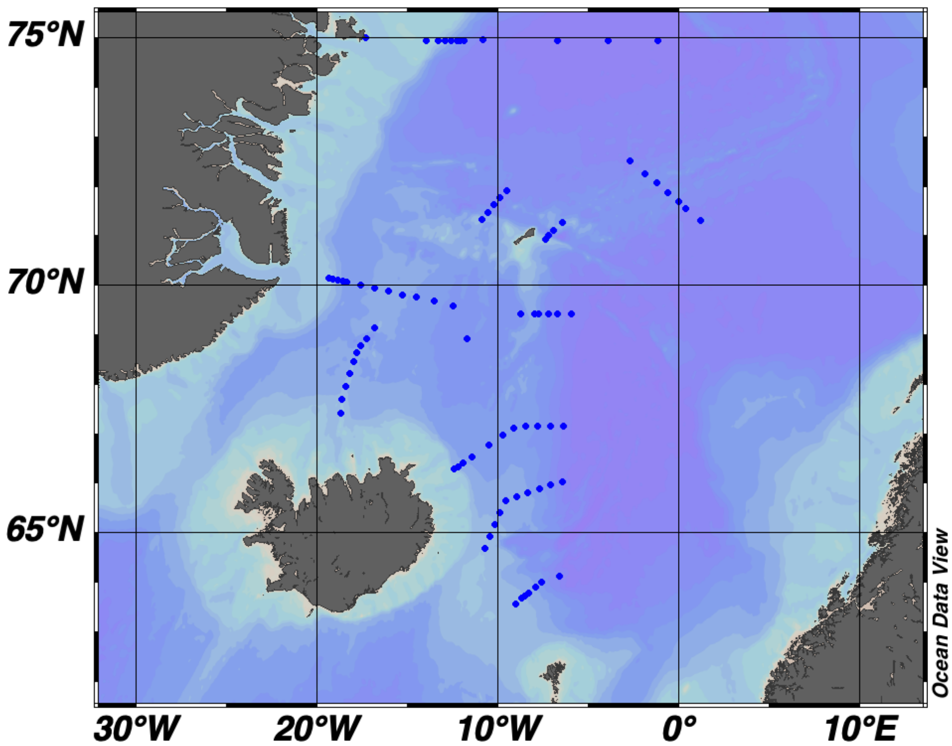


Figure H1: Location of stations sampled for chemistry by the Bergen group during AR84-03.

CFC-12 and SF_6 analyses

Samples for analysis of CFC-12 and SF_6 were taken from the Niskin bottles in 250-ml glass syringes, which were stored cold in a cool room that was kept at 0°C, and analysis took place within six hours after sampling. The analysis is based on purge-and-trap work-up of the water samples followed by gas chromatographic separation and electron capture detection of the different compounds; the analytical technique is described by Bullister et al. (2008) and Stöven and Tanhua (2014).

The standardisation was achieved by calibration gas prepared at Deuste Steininger GmbH, Mühlhausen, Germany, and cross-calibrated against gas prepared at Scripps Institute of Oceanography. The standard gases were calibrated against the SIO-05 scale.

Overall, the instrument worked very well during the cruise. SF_6 is most valuable for the upper ocean, with recently ventilated water masses. Due to the change in the atmospheric evolution of CFC-12 since the early 2000s, with first a slowdown followed by a decline, the usefulness of this tracer for recently ventilated water masses is limited, such as the mixed layer. However, the higher concentrations in seawater, compared with SF_6, makes CFC-12 the preferred tracer for the deeper part of the water column. In total 993 samples were collected for transient tracers.

Winkler oxygen

Dissolved oxygen concentration samples were taken from each Niskin into ~125 ml volume calibrated glass flasks with stoppers and pickled using manganese chloride and sodium hydroxide/sodium iodide. Samples were stored in a dark environment for up to 15 hours before analysis. Oxygen concentrations were determined using Winkler titration on an automated instrument designed and built at Scripps Institution of Oceanography, in which the pickled sample was reacted with sulphuric acid and titrated with sodium thiosulfate until the photometric endpoint was detected. Before the instrument was started each day, four blanks and four potassium iodate standards were measured. One duplicate sample was taken at most stations. From these duplicates, the precision of the measurements was determined to be ± 0.004 ml/l. Chemical reagents were prepared in June 2024, in the lab in Bergen. Two potassium iodate standards were used- one prepared in the lab in Bergen in June 2024 and one purchased from OSIL. These were alternated throughout the cruise. The instrument functioned very well throughout the cruise. In total 1030 samples were collected for oxygen.

Inorganic carbon

We collected 192 samples to be analyzed for dissolved inorganic carbon (DIC) and total alkalinity (TA). Samples were drawn from each Niskin bottle, in 250- or 500-ml glass bottles and preserved with 0.05- or 0.15-ml of saturated mercuric chloride. These samples will be analyzed on shore at the lab back in Bergen, for DIC by coulometric titration using a VINDTA 3D and for TA by potentiometric titration using a VINDTA 3S.

Nutrients

During the cruise we collected 612 samples to be analyzed for nutrients (phosphate, nitrate and silicate). At these stations, samples were drawn from each Niskin into 24 ml scintillation vials and preserved with 0.2 ml chloroform. These samples will be analyzed on shore by our Icelandic colleagues at the Marine and Freshwater Research Institute, using an auto analyzer. At the ship the samples were stored cold and in the dark.

References

Bullister, J. L., and D. P. Wisegarver (2008), The shipboard analysis of trace levels of sulfur hexafluoride, chlorofluorocarbon-11 and chlorofluorocarbon-12 in seawater, *Deep-Sea Res. I*, *55*(8), 1063-1074.

Stöven, T., and T. Tanhua (2014), Ventilation of the Mediterranean Sea constrained by multiple transient tracer measurements, *Ocean Sci.*, *10*(3), 439-457.

I: Outreach

Contributed by H. Chanatry

I joined the cruise as the media outreach representative; my role was to document the experience and produce a to-be-determined media package, independently of the scientific operations of the project. In this capacity, I had a story proposal accepted by *National Geographic* about midway through the cruise; this will be completed in the months following the end of the cruise, tentatively published by the end of the year.

At the beginning of the cruise, I focused my efforts on documenting the mooring deployment, as this occurred for a limited amount of time; this also allowed me to get used to the operations of a ship and how to record sound and images safely, as this was my first time on a research expedition.

When we reached the Faroe Islands, I spoke with locals about their perspectives on the sea and the ocean currents – including those in the region being studied by this expedition.

After the Faroe Islands, I spent a significant amount of time capturing different perspectives on the scientific process on board, including CTD deployments (from the researchers, bridge, and winch operators, and at different times of day), water sampling, and sample processing. I conducted interviews with the scientists involved. I also shadowed different members of the ship's crew, specifically members of the engineering team, the galley team, and the tech team, about the experience of life at sea.

I prioritized gathering information for written and audio production, as well as photography.

Following the cruise, I will conduct several follow-up interviews with the scientists as they process and analyze their data. These will be included in my story development for *National Geographic*, which will focus on the large-scale story of the research on this cruise and the importance of these regional currents in the context of the AMOC. I will also pitch additional stories to other outlets.

J: Glider Deployment

Contributed by S. Semper and A. Brakstad

Seaglider SG563 was deployed during Leg 1 through the aft A-frame on 23 August 2024 10:54 UTC at the location 63˚N 43.005' and 8˚W 27.768'. SG563 is a 1000-meter depth rated glider equipped with: Seabird CT-sail (SBE41 sn. 263), Kistler pressure sensor (sn. 5023283), Aanderaa oxygen optode (4330F sn. 799), and Wetlabs ECO puck sensor (BB2FLVMT sn. 871). The ECO puck sensor will be turned off throughout the deployment to save energy.

During the cruise, the glider navigated from the deployment site (near mooring UFO3) to the UFO8 mooring site, then it occupied the outermost part of the Faroe Ridge section between 63˚N 59.500' / 7˚W 33.762' and 64˚N 10.998' / 6˚W 00.000'. The glider will continue to operate along this section for the remainder of its mission (~9 months) to complement the mooring array. When it is recovered it will be replaced by another glider to obtain a full year of measurements. The glider transmits all data in near real time.

For post calibration purposes, the glider was coordinated to operate in the vicinity of the shipboard CTD casts taken near UFO9 (CTD station 29) and UFO8 (CTD station 30) at Section Faroe Ridge Repeat section at the beginning of leg 2 (see Fig. C1).

Details of the UIB mooring UFO9

The UIB mooring UFO9 was deployed during Leg 1 on 26 August 2024 at 15:35 UTC. The anchor went overboard at the location 64˚ 3.9632' N and 7˚ 4.5978' W ("splash position"); the target location, including the fallback, is estimated to be at 64˚ 3.950' N and 7˚ 4.210' W at a bottom depth of 2417 m. No triangulation of the anchor position was conducted, as the deck unit for this type of release was not available. The 2217 m-long mooring was equipped with a total of 29 instruments (see Appendix B for the mooring diagram and Table J1 for the times the instruments went overboard): 3 ADCPs (1 Nortek S55, 1 Nortek S100, 1 RDI 75 kHz); 2 Aanderaa SeaGuards; 11 MicroCATs (7 SBE37 CTD, 4 SBE37 CT), 1 SBE39 TP; and 12 T loggers (11 SBE57, 1 RBR-T). One Xeos beacon (UFO UIB 2024, IMEI 300234063956250, loaned from WHOI) was mounted to the uppermost 47' buoyancy sphere. Two CTD casts were performed in the vicinity of the mooring as part of Sections FR and FRR: station 23 approximately one day before and station 29 approximately three days after the deployment. Prior to the deployment, the 11 MicroCATs were mounted on the CTD rosette for calibration purposes on station 25.

Table J1: UIB mooring UFO9 deployment log sheet.

		actual (target, not surveyed)	
Latitude (N)		64 03.950 N	
Longitude (W)		07 04.210 W	
Depth (m)		2417 m	
Xeos mono		N/A	
Release 1		1868	
Release 2		N/A	
Buoy Over		26/08/2024 at 12:30 UTC	
Anchor Over		26/08/2024 at 15:35 UTC	
Release Fired			
Instrument	**Deploy Depth**	**Serial Number**	**Time Deployed**
SBE37-CTD	205	6017	12:31
SBE56-T	225	1337	12:36
SBE56-T	250	1338	12:37
SBE56-T	275	1339	12:39
SBE37-CTD	300	6018	12:41
SBE56-T	325	1341	12:43
SBE56-T	350	1335	12:44
SBE37-CTD	390	7373	12:46
Nortek S100 ADCP	400	100756	12:59
XEOS mono	400	UFO UIB 2024, IMEI 300234063956250	12:59
Nortek S55 ADCP	400	200062	12:59
SBE56-T	450	1345	13:03
SBE37-CTD	500	7224	13:06
SBE56-T	550	1343	13:09
SBE56-T	600	1947	13:11
SBE37-CTD	650	8970	13:14
SBE56-T	700	1333	13:16
SBE56-T	750	1331	13:18
SBE37-CTD	800	8000	13:21
SBE56-T	900	1332	13:25
SBE37-CTD	995	7223	13:29
SeaGurad CTD	1000	1902	13:32
RDI 75kHz ADCP	1200	18447	13:46
SBE37-CTD	1300	8971	13:51
SBE37-CTD	1500	7336	13:57
RBR-T	1600	202505	14:02
SBE39-TP	1700	3143	14:07
SeaGuard CTD	1807	1904	14:16
SBE37-CTD	1812	7334	14:18
SBE37-CTD	2317	4096	14:36

Appendix A: AR84-03 Event Log

UFO: Upstream Pathways of the Faroe Overflow							
AR84-03 operations Color coding as follows: blue, logistical events; red, mooring deployment; green, water sampling; purple, glider deployment							
	CTD Station Number	**Station Name**	**Latitude (deg/min N)**	**Longitude (deg/min W)**	**Corrected Depth (m)**	**Station Notes**	**Post-station Notes**
CTD School, 18-Aug-2024 14:00 UTC							
Safety briefing, 19-Aug-2024 08:30 UTC							
DEPART from Reykjavik, 19-Aug-2024 10:30 UTC							
Drills 19-Aug-2024 12:30 UTC on the transit to UFO mooring line							
	1	Test	63 06.30	17 13.41	1192	test cast, microcats test, water sampling	stop 10 minutes at three depths for microcats calibration, with salinity samples
	2	Test	63 06.29	17 12.71	1223	test cast, mooring releases test, no sampling	One of four releases failed
Continue transit to UFO mooring line							
XBT sound speed correction before mooring deployment, 21-Aug-2024 9:00 UTC							
UFO line starts with multi-beam bottom depth reading toward first mooring site, 21-Aug-2024 10:00 UTC							
UFO1 Mooring deployment starts 21-Aug-2024 12:30 UTC and ends 14:26 UTC							
Mooring		UFO1	63 36.18	08 51.10	643		
Acoustic survey for mooring location							
	3	FR-1	63 29.53	09 13.08	554	water sampling (salts)	batch processing unhappy in different way due to the removal of second oxygen sensor, fixed before next station

	4	FR-2	63 31.31	09 07.48	585	No sampling	
	5	FR-3	63 33.07	09 02.00	611	No sampling	
	6	FR-4	63 34.79	08 56.42	630	water sampling (salts)	
	7	FR-5	63 36.60	08 50.76	648	No sampling	
	8	FR-6	63 38.15	08 45.12	679	water sampling (salts)	
	9	FR-7	63 39.75	08 40.36	713	No sampling, mooring releases test	
UFO2 Mooring deployment starts 22-Aug-2024 9:00 UTC and ends 10:38 UTC							
Mooring		UFO2	63 39.69	08 39.82	720		
Acoustic survey for mooring location							
	10	FR-8	63 41.65	08 34.29	755	No sampling	
	11	FR-9	63 43.11	08 29.05	803	water sampling (salts)	
	12	FR-10	63 44.80	08 23.51	855	No sampling	
	13	FR-11	63 46.51	08 18.07	926	No sampling, mooring releases test	
	14	FR-12	63 48.25	08 12.67	1003	No sampling, mooring releases test	fired a bottle at the beginning of downcast, CTD was recovered and redeployed, hex file overwritten
	15	FR-13	63 49.97	08 06.84	1089	water sampling (salts)	
	16	FR-14	63 51.69	08 01.01	1168	No sampling	first salinity sensor very noisy during downcast, rinse the sensor after CTD on deck
	17	FR-15	63 53.37	07 55.53	1244	No sampling	
UFO3 Mooring deployment starts 23-Aug-2024 08:00 UTC and ends 09:44 UTC							
Mooring		UFO3	63 43.11	08 28.87	805		
Acoustic survey for mooring location							
UIB sea glider SG563 deployment 23-Aug-2024 10:54 UTC							
Glider			63 43.01	08 27.77			
UFO4 Mooring deployment starts 23-Aug-2024 13:00 UTC and ends 15:06 UTC							
Mooring		UFO4	63 46.47	08 17.89	930		
Acoustic survey for mooring location							
	18	FR-16	63 54.97	07 50.37	1321	No sampling, mooring releases test	
	19	FR-17	63 56.69	07 44.68	1420	water sampling (salts)	clear CTD pin hole
	20	FR-18	63 58.50	07 39.14	1524	No sampling	
	21	FR-19	64 00.06	07 33.43	1646	No sampling	
UFO5 Mooring deployment starts 24-Aug-2024 08:00 UTC and ends 09:54 UTC							
Mooring		UFO5	63 50.04	08 06.47	1084		
Acoustic survey for mooring location							
UFO6 Mooring deployment starts 24-Aug-2024 13:00 UTC and ends 15:16 UTC							
Mooring		UFO6	63 53.37	07 55.40	1236		
Acoustic survey for mooring location							
	22	FR-20	64 01.97	07 18.86	2068	mooring releases test, tracer sampling test	
	23	FR-21	64 03.25	07 05.86	2367	water sampling (salts)	

	24	FR-22	64 05.19	06 49.01	2656	No sampling	
UFO7 Mooring deployment starts 25-Aug-2024 08:00 UTC and ends 10:09 UTC							
Mooring		UFO7	63 56.72	07 44.87	1408		
Acoustic survey for mooring location							
UFO8 Mooring deployment starts 25-Aug-2024 13:00 UTC and ends 15:08 UTC							
Mooring		UFO8	63 59.98	07 33.88	1615		
Acoustic survey for mooring location							
	25	Test	64 03.22	07 06.64	2361	UIB microcast test, tracer sampling test	
	26	FR-23	64 06.99	06 33.47	2840	No sampling	
	27	FR-24	64 08.68	06 19.01	3299	No sampling	
UFO9 Mooring deployment starts 26-Aug-2024 12:00 UTC and ends 15:35 UTC							
Mooring		UFO9	64 03.95	07 04.21	2417		
Transit to UFO10 mooring for bath survey							
Transit to Torshavn and arrive in 27-Aug-2024 09:00 UTC							
Depart Torshavn and transit to section FRR, 28-Aug-2024 09:00 UTC							
	28	FRR-1	64 07.26	06 34.24	2764	water sampling (salts, O2, CFC, nutrients)	
	29	FRR-2	64 04.78	07 04.38	2425	No sampling	
	30	FRR-3	64 00.58	07 33.79	1620	water sampling (salts, O2, CFC, nutrients)	restarted (overwrote) file while at 10m due to scan length error
	31	FRR-4	63 57.14	07 45.27	1407	No sampling	
	32	FRR-5	63 53.78	07 54.65	1251	water sampling (O2, CFC, nutrients)	
	33	FRR-6	63 50.39	08 05.67	1100	No sampling	
	34	FRR-7	63 46.79	08 17.06	938	water sampling (salts, O2, CFC, nutrients)	
	35	FRR-8	63 43.77	08 28.79	812	water sampling (O2, CFC, nutrients, radionuclide, 14C, DO14C)	
	36	FRR-9	63 40.19	08 39.48	717	water sampling (salts, O2, CFC, nutrients)	
	37	FRR-10	63 36.56	08 49.73	651	No sampling	
	38	FRR-11	63 33.08	09 00.78	610	water sampling (salts, O2, CFC, nutrients)	forgot to hit NAV file at beginning, did at 200m (scan number corrected after the cast when processing data)
Finish section FRR and transit to section KR, 29-Aug-2024 21:40 UTC							
	39	KR-1	64 36.57	10 47.96	415	No sampling	did not enter bottom depth in the file header before starting data acquisition
	40	KR-2	64 41.26	10 42.25	423	water sampling (salts, O2, CFC)	
	41	KR-3	64 45.92	10 36.88	429	No sampling	
	42	KR-4	64 51.16	10 30.90	431	No sampling	
	43	KR-5	64 55.97	10 25.39	437	water sampling (salts, O2, CFC)	
	44	KR-6	65 00.80	10 19.51	454	No sampling	
	45	KR-7	65 05.48	10 13.93	538	No sampling	

	46	KR-8	65 10.28	10 08.04	650	water sampling (salts, O2, CFC)	
	47	KR-9	65 14.87	10 02.01	763	No sampling	
	48	KR-10	65 19.61	09 56.87	823	No sampling	difference between first and second temperature sensors up to 0.3 in top 50m of upcast
	49	KR-11	65 24.76	09 50.77	835	water sampling (salts, O2, CFC)	
	50	KR-12	65 29.78	09 44.96	842	No sampling	
	51	KR-13	65 34.38	09 39.40	826	No sampling	
	52	KR-14	65 39.14	09 32.97	802	water sampling (salts, O2, CFC)	
	53	KR-15	65 40.87	09 21.33	797	No sampling	
	54	KR-16	65 42.34	09 08.51	795	No sampling	
	55	KR-17	65 43.80	08 55.94	794	water sampling (salts, O2, CFC)	
	56	KR-18	65 45.29	08 43.42	842	No sampling	
	57	KR-19	65 46.84	08 30.78	950	water sampling (radionuclide)	
	58	KR-20	65 48.57	08 18.40	1164	water sampling (salts, O2, CFC)	
	59	KR-21	65 50.18	08 05.80	1424	No sampling	
	60	KR-22	65 51.54	07 53.19	1612	No sampling	
	61	KR-23	65 52.96	07 39.95	1715	water sampling (salts, O2, CFC)	
	62	KR-24	65 54.04	07 28.23	1793	No sampling	
	63	KR-25	65 56.05	07 15.29	1952	No sampling	
	64	KR-26	65 57.83	07 02.79	2155	water sampling (salts, O2, CFC)	
	65	KR-27	65 59.08	06 49.64	2375	No sampling	
	66	KR-28	66 00.50	06 36.69	2656	No sampling	
	67	KR-29	66 02.11	06 24.32	2980	water sampling (salts, O2, CFC, 14C)	
Finish section KR and transit to section LE, 01-Sep-2024 10:10 UTC							
	68	LE-1	67 09.58	06 22.35	2844	water sampling (O2, CFC, DIC/TA, nutrients, radionuclide, 14C, DO14C)	
	69	LE-2	67 09.79	06 35.95	2603	No sampling	stop CTD at 2000m
	70	LE-3	67 09.76	06 50.04	2400	No sampling	stop CTD at 2000m
	71	LE-4	67 09.57	07 04.14	2173	water sampling (salts, O2, CFC, nutrients)	stop CTD at 2000m
	72	LE-5	67 09.78	07 18.13	2094	No sampling	stop CTD at 2000m
	73	LE-6	67 09.59	07 32.06	1958	No sampling	
	74	LE-7	67 09.69	07 45.91	1767	water sampling (salts, O2, CFC, DIC/TA, nutrients)	
	75	LE-8	67 09.65	08 00.13	1620	No sampling	
	76	LE-9	67 09.81	08 14.31	1599	No sampling	
	77	LE-10	67 09.75	08 27.63	1609	water sampling (salts, O2, CFC, nutrients)	
	78	LE-11	67 09.73	08 41.91	1641	No sampling	
	79	LE-12	67 09.77	08 55.27	1609	No sampling	

	80	LE-13	67 06.77	09 07.35	1625	water sampling (salts, O2, CFC, nutrients)	
	81	LE-14	67 03.77	09 19.07	1561	No sampling	
	82	LE-15	67 00.87	09 30.76	1438	No sampling	
	83	LE-16	66 57.94	09 42.39	1546	water sampling (salts, O2, CFC, DIC/TA, nutrients)	
	84	LE-17	66 55.14	09 53.86	1541	No sampling	
	85	LE-18	66 52.17	10 05.48	1481	No sampling	
	86	LE-20	66 46.40	10 29.01	1385	water sampling (salts, O2, CFC, nutrients)	
	87	LE-22	66 40.40	10 51.70	1455	No sampling	
	88	LE-24	66 34.67	11 14.37	1420	No sampling	
	89	LE-25	66 31.75	11 25.82	1379	water sampling (salts, O2, CFC, DIC/TA, nutrients)	from 200m to surface (upcast) sensors difference increases
	90	LE-26	66 28.86	11 37.28	1305	No sampling	
	91	LE-27	66 26.08	11 48.76	1219	No sampling	
	92	LE-28	66 24.55	11 54.28	1182	water sampling (salts, O2, CFC, nutrients)	
	93	LE-29	66 23.01	12 00.24	1055	No sampling	
	94	LE-30	66 21.56	12 05.87	1045	No sampling	
	95	LE-31	66 20.06	12 11.68	957	water sampling (salts, O2, CFC, DIC/TA, nutrients)	
	96	LE-32	66 18.78	12 17.04	847	No sampling	
	97	LE-33	66 17.19	12 22.66	453	water sampling (O2, CFC, DIC/TA, nutrients)	
	98	LE-34	66 15.71	12 28.40	245	No sampling	
Finish section LE and transit to section SFZ, 04-Sep-2024 8:20 UTC							
	99	SFZ-01	67 25.28	18 37.94	355	water sampling (O2, CFC, nutrients)	
	100	SFZ-02	67 30.67	18 37.37	350	No sampling	
	101	SFZ-03	67 36.17	18 36.91	366	No sampling	
	102	SFZ-04	67 41.49	18 36.28	484	water sampling (O2, CFC, nutrients)	
	103	SFZ-05	67 46.63	18 31.93	373	No sampling	difference between first and second temperature sensors
	104	SFZ-06	67 51.75	18 27.62	490	No sampling	
	105	SFZ-07	67 56.93	18 23.36	563	water sampling (salts, O2, CFC, nutrients)	
	106	SFZ-08	68 02.05	18 18.98	688	No sampling	
	107	SFZ-09	68 07.34	18 14.47	655	No sampling	
	108	SFZ-10	68 12.48	18 10.04	515	water sampling (salts, O2, CFC, nutrients)	
	109	SFZ-11	68 17.57	18 05.92	710	No sampling	
	110	SFZ-12	68 22.63	18 01.54	786	No sampling	
	111	SFZ-13	68 27.85	17 57.27	671	water sampling (salts, O2, CFC, nutrients)	
	112	SFZ-14	68 32.94	17 52.76	940	No sampling	
	113	SFZ-15	68 38.03	17 47.97	899	water sampling (salts, O2, CFC, nutrients)	

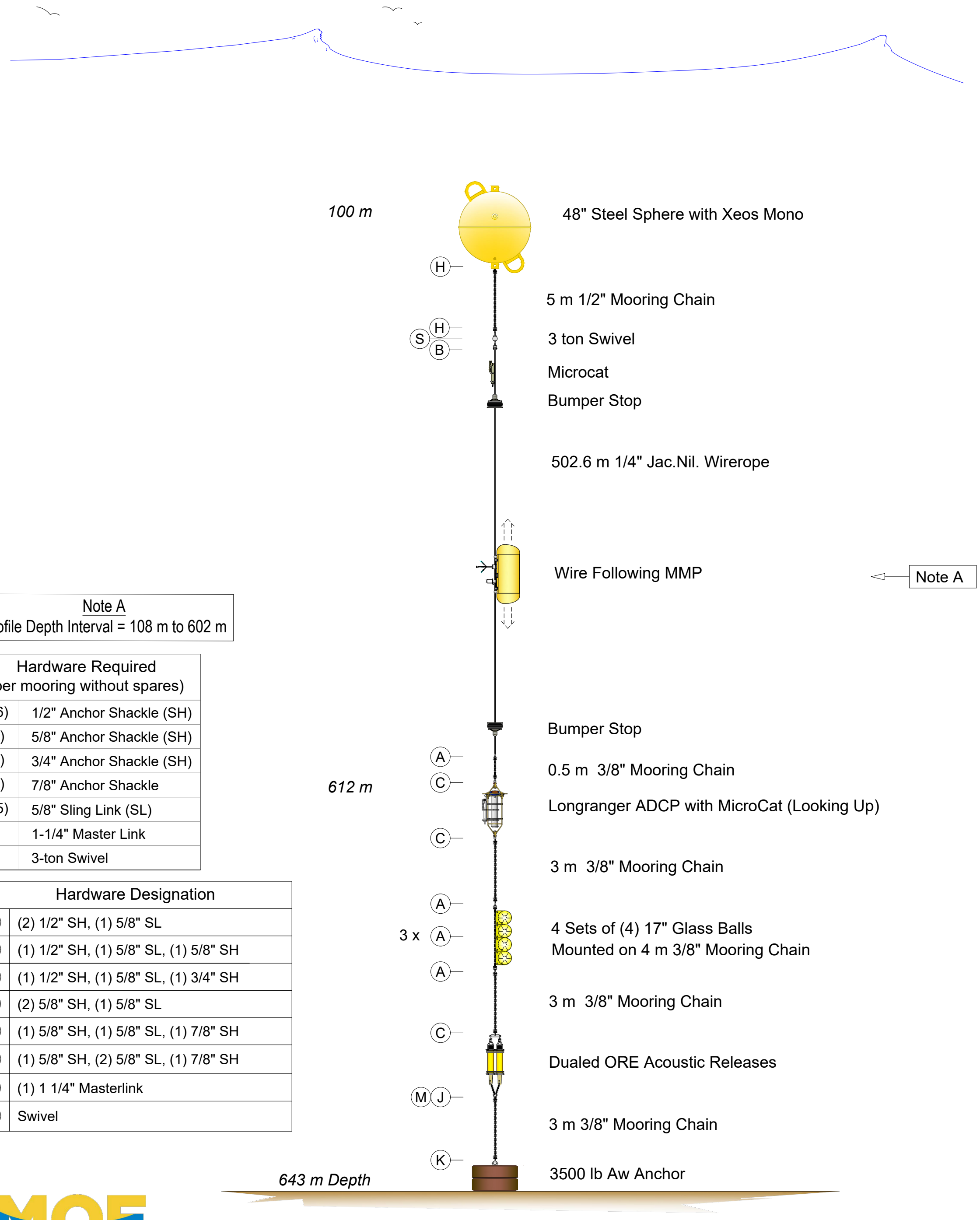
	114	SFZ-16	68 42.46	17 41.84	1002	water sampling (radionuclide, 14C, DO14C)	
	115	SFZ-17	68 46.81	17 33.11	1265	water sampling (O2, CFC, nutrients)	
	116	SFZ-18	68 51.11	17 23.76	1358	No sampling	
	117	SFZ-19	68 55.29	17 14.46	1474	water sampling (salts, O2, CFC, nutrients)	
	118	SFZ-20	68 59.59	17 05.60	1481	water sampling (radionuclide, 14C, DO14C)	
	119	SFZ-21	69 03.76	16 56.44	1751	No sampling	
	120	SFZ-22	69 08.03	16 47.23	688	water sampling (salts, O2, CFC, nutrients)	
	121	SFZ-23	69 12.45	16 38.18	882	No sampling	
Finish section SFZ and transit to section IS, 06-Sep-2024 11:40 UTC							
	122	IS-1	70 08.22	19 20.45	346	water sampling (O2, CFC, nutrients)	wrong bottom depth put in the header of ctd file
	123	IS-2	70 06.97	19 00.05	412	water sampling (O2, CFC, DIC/TA, nutrients, radionuclide)	
	124	IS-3	70 05.82	18 49.55	913	water sampling (O2, CFC, DIC/TA, nutrients, radionuclide, 14C)	
	125	IS-4	70 04.61	18 34.25	1278	water sampling (O2, CFC, DIC/TA, nutrients, radionuclide)	
	126	IS-5	70 03.46	18 18.62	1503	water sampling (O2, CFC, DIC/TA, nutrients)	
	127	IS-6	70 02.34	18 03.44	1604	No sampling	
	128	IS-7	70 01.05	17 47.99	1616	No sampling	
	129	IS-8	69 59.90	17 32.42	1593	water sampling (salts, O2, CFC, nutrients)	
	130	IS-9	69 58.61	17 17.01	1328	No sampling	
	131	IS-10	69 57.37	17 01.81	1225	No sampling	
	132	IS-11	69 56.22	16 47.01	1027	water sampling (salts, O2, CFC, nutrients)	
	133	IS-12	69 55.01	16 31.54	1122	No sampling	
	134	IS-13	69 53.81	16 16.20	1033	No sampling	
	135	IS-14	69 52.61	16 00.79	936	water sampling (salts, O2, CFC, nutrients)	
	136	IS-15	69 51.33	15 45.23	1187	No sampling	
	137	IS-16	69 00.50	15 29.98	1116	No sampling	
	138	IS-17	69 48.78	15 14.41	1075	water sampling (salts, O2, CFC, DIC/TA, nutrients)	
	139	IS-18	69 47.65	14 59.65	1218	No sampling	
	140	IS-19	69 46.46	14 44.59	1396	No sampling	
	141	IS-20	69 45.28	14 29.43	1396	water sampling (O2, CFC, DIC/TA, nutrients)	
	142	IS-21	69 44.06	14 14.12	1387	No sampling	
	143	IS-22	69 42.88	13 59.02	1612	No sampling	
	144	IS-23	69 40.48	13 28.49	1606	water sampling (salts, O2, CFC, DIC/TA, nutrients)	

	145	IS-24	69 38.05	12 57.40	1894	water sampling (radionuclide, 14C, DO14C)	
	146	IS-25	69 35.49	12 28.27	1841	water sampling (salts, O2, CFC, nutrients)	
Finish section IS and transit to section JME, 08-Sep-2024 17:10 UTC							
	147	JME-01	70 53.90	07 27.41	314	No sampling	wrong bottom depth put in the header of ctd file
	148	JME-02	70 55.86	07 21.84	344	water sampling (CFC)	
	149	JME-03	70 57.93	07 16.31	684	No sampling	
	150	JME-04	70 59.94	07 10.84	1681	water sampling (CFC)	
	151	JME-05	71 01.97	07 05.24	2401	water sampling (radionuclide, 14C)	
	152	JME-06	71 03.95	06 59.63	2158	No sampling	
	153	JME-07	71 05.95	06 54.01	1318	water sampling (CFC)	
	154	JME-08	71 07.89	06 48.59	978	No sampling	
	155	JME-09	71 11.95	06 37.18	1043	No sampling	
	156	JME-10	71 16.02	06 25.63	754	water sampling (CFC)	
Finish section JME and transit to hide behind Jan Mayen Island due to the storm, 09-Sep-2024 19:20 UTC							
Transit to section GSS, 13-Sep-2024 12:00 UTC							
	157	GSS-01	71 18.09	-02 46.31	2212	water sampling (salts, O2, CFC)	
	158	GSS-02	71 22.01	-02 58.38	2886	water sampling (radionuclide, 14C, DO14C)	
	159	GSS-03	71 25.82	-01 10.06	2749	No sampling	
	160	GSS-04	71 29.61	-01 22.19	3005	No sampling	Seasave software crashed during the upcast; stopped firing bottles and recovered CTD.
	161	GSS-05	71 33.52	-01 34.46	2726	water sampling (salts, O2, CFC)	
	162	GSS-06	71 37.31	-01 46.40	2475	No sampling	
	163	GSS-07	71 41.15	-01 58.54	2283	water sampling (salts, O2, CFC)	vent cap lost for Niskin bottle 10
	164	GSS-08	71 44.88	00 10.90	2495	No sampling	
	165	GSS-09	71 48.67	00 23.32	1883	No sampling	
	166	GSS-10	71 52.50	00 35.39	1980	water sampling (salts, O2, CFC)	
	167	GSS-11	71 56.32	00 47.72	2565	No sampling	
	168	GSS-12	72 00.13	00 59.96	2436	water sampling (radionuclide, 14C)	
	169	GSS-13	72 03.94	01 12.55	2064	water sampling (salts, O2, CFC)	first salinity sensor weird, use second salinity sensor for this cast
	170	GSS-14	72 07.75	01 24.81	2366	No sampling	
	171	GSS-15	72 11.60	01 37.43	2232	No sampling	
	172	GSS-16	72 15.41	01 49.64	2460	water sampling (salts, O2, CFC)	
	173	GSS-17	72 22.97	02 14.76	2853	No sampling	
	174	GSS-18	72 30.55	02 40.25	2980	water sampling (salts, O2, CFC)	
Finish section GSS and transit to section GS, 16-Sep-2024 05:30 UTC							

	175	GS-00	75 00.18	17 15.44	88	water sampling (salts, O2, CFC, nutrients, radionuclide, 14C)	most onshore station, distance to land is 1.8 nm.
Break for Arctic circle crossing ceremony, began 16-Sep-2024 13:00 UTC							
	176	GS-01	74 57.10	13 56.68	183	water sampling (O2, CFC, DIC/TA, nutrients)	
	177	GS-02	74 57.26	13 36.09	206	water sampling (radionuclide, 14C)	
	178	GS-03	74 57.19	13 15.18	259	water sampling (O2, CFC, DIC/TA, nutrients)	
	179	GS-04	74 57.19	12 54.14	502	water sampling (O2, CFC, DIC/TA, nutrients, radionuclide, 14C)	
	180	GS-05	74 57.13	12 00.34	1068	water sampling (O2, CFC, DIC/TA, nutrients, radionuclide, 14C, DO14C)	
	181	GS-06	74 57.20	12 12.59	1612	water sampling (O2, CFC, DIC/TA, nutrients, radionuclide, 14C)	
	182	GS-07	74 57.19	11 51.72	2015	water sampling (salts, O2, CFC, DIC/TA, nutrients)	snowing
	183	GS-08	74 57.13	11 30.91	2374	No sampling	took a long time before temperature sensor stabilized. stop CTD at 2000m
	184	GS-09	74 57.25	11 09.91	2662	water sampling (salts)	stop CTD at 2000m
	185	GS-10	74 57.29	10 49.19	2932	water sampling (O2, CFC, DIC/TA, nutrients, radionuclide)	stop CTD at 2000m
	186	GS-11	74 57.23	10 07.70	3154	No sampling	stop CTD at 2000m
	187	GS-12	74 57.25	09 26.38	3240	No sampling	stop CTD at 2000m
	188	GS-13	74 57.32	06 39.93	3430	water sampling (salts, O2, CFC, DIC/TA, nutrients)	stop CTD at 2000m
	189	GS-14	74 57.36	03 53.49	3591	water sampling (O2, CFC, nutrients)	stop CTD at 2000m
	190	GS-15	74 57.35	01 07.02	3696	water sampling (salts, O2, CFC, DIC/TA, nutrients, radionuclide, 14C, DO14C)	deepest station, oxygen profile weird after 900 m
Finish section GS and transit to section JMW, 19-Sep-2024 14:30 UTC							
	191	JMW-01	71 54.75	09 30.28	2519	water sampling (salts, O2, CFC)	oxygen sensor still weird, replaced the senor using spare one after the cast
	192	JMW-02	71 50.37	09 40.90	2456	No sampling	hit NAV file at 36 m during down cast, NAV info corrected after the cast when data processing
	193	JMW-03	71 46.07	09 50.94	2417	water sampling (O2, CFC)	
	194	JMW-04	71 41.68	10 01.23	2362	No sampling	
	195	JMW-05	71 37.31	10 11.25	2283	water sampling (salts, O2, CFC)	snowing
	196	JMW-06	71 32.98	10 21.45	2350	No sampling	
	197	JMW-07	71 28.68	10 31.59	1808	water sampling (salts, O2, CFC, radionuclide)	
	198	JMW-08	71 24.22	10 41.85	1113	No sampling	
	199	JMW-09	71 00.20	10 51.85	706	water sampling (salts, O2, CFC)	

Finish section JMW and transit to section JMR, 21-Sep-2024 11:20 UTC							
	200	JMR-01	69 25.41	08 44.04	2107	water sampling (salts, O2, CFC)	
	201	JMR-02	69 25.42	08 28.38	1703	No sampling	
	202	JMR-03	69 25.42	08 13.10	992	No sampling	
	203	JMR-04	69 25.39	07 57.69	935	water sampling (O2, CFC)	large sensor difference, had to restart cast, flush and clear pin hole on deck, and redeploy
	204	JMR-05	69 25.32	07 43.18	1303	water sampling (salts, O2, CFC, nutrients, 14C)	large sensor difference again, flush, clear pin hole, and redeploy (biology things found near CTD sensors)
	205	JMR-06	69 25.39	07 27.05	1984	No sampling	
	206	JMR-07	69 25.39	07 11.81	2350	water sampling (salts, O2, CFC, nutrients, 14C, DO14C)	
	207	JMR-08	69 25.37	06 56.55	2468	No sampling	
	208	JMR-09	69 25.34	06 41.29	2581	water sampling (salts, O2, CFC)	
	209	JMR-10	69 25.45	06 25.74	2735	No sampling	
	210	JMR-11	69 25.39	06 10.41	2886	No sampling	
	211	JMR-12	69 25.28	05 55.22	2989	water sampling (salts, O2, CFC)	
Finish section JMR and transit to section IGS, 23-Sep-2024 02:30 UTC							
	212	ISG-01	68 54.72	11 40.10	1880	water sampling (salts, O2, CFC, nutrients, radionuclide, 14C, DO14C)	
Finish section IGS and begin transit to Reykjavik, 23-Sep-2024 16:30 UTC							

Appendix B: Mooring Diagrams



Note A
Profile Depth Interval = 108 m to 602 m

Hardware Required (per mooring without spares)	
(16)	1/2" Anchor Shackle (SH)
(8)	5/8" Anchor Shackle (SH)
(3)	3/4" Anchor Shackle (SH)
(2)	7/8" Anchor Shackle
(15)	5/8" Sling Link (SL)
1	1-1/4" Master Link
1	3-ton Swivel

Hardware Designation	
A	(2) 1/2" SH, (1) 5/8" SL
B	(1) 1/2" SH, (1) 5/8" SL, (1) 5/8" SH
C	(1) 1/2" SH, (1) 5/8" SL, (1) 3/4" SH
H	(2) 5/8" SH, (1) 5/8" SL
J	(1) 5/8" SH, (1) 5/8" SL, (1) 7/8" SH
K	(1) 5/8" SH, (2) 5/8" SL, (1) 7/8" SH
M	(1) 1 1/4" Masterlink
S	Swivel

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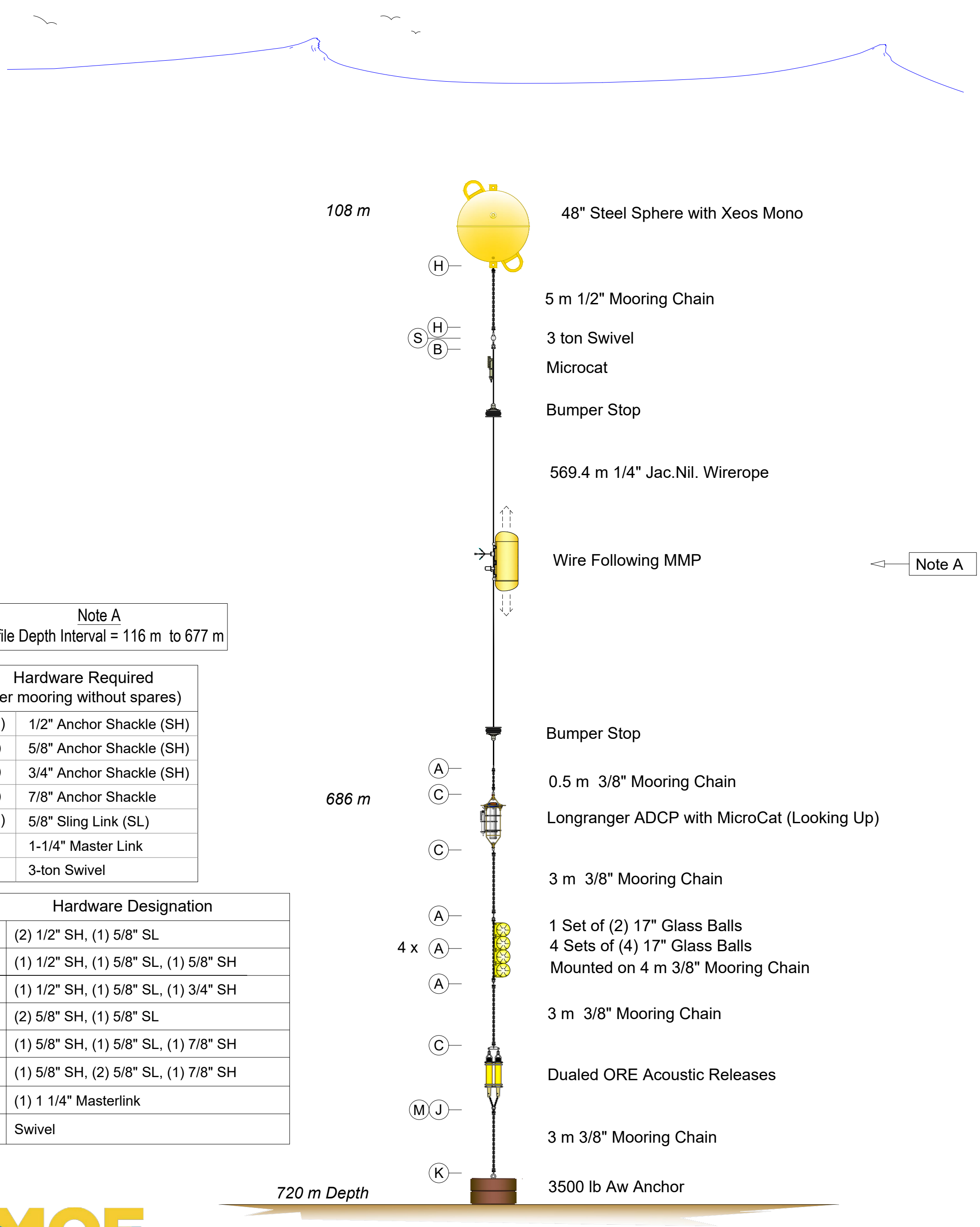
UFO-1
As Deployed

Woods Hole Oceanographic Institution	
designed by John Kemp, drawn by Jim Ryder	
file: Pickart_UFO	date: 10/18/2024



Note A
Profile Depth Interval = 116 m to 677 m

Hardware Required (per mooring without spares)	
(18)	1/2" Anchor Shackle (SH)
(8)	5/8" Anchor Shackle (SH)
(3)	3/4" Anchor Shackle (SH)
(2)	7/8" Anchor Shackle
(16)	5/8" Sling Link (SL)
1	1-1/4" Master Link
1	3-ton Swivel

Hardware Designation	
A	(2) 1/2" SH, (1) 5/8" SL
B	(1) 1/2" SH, (1) 5/8" SL, (1) 5/8" SH
C	(1) 1/2" SH, (1) 5/8" SL, (1) 3/4" SH
H	(2) 5/8" SH, (1) 5/8" SL
J	(1) 5/8" SH, (1) 5/8" SL, (1) 7/8" SH
K	(1) 5/8" SH, (2) 5/8" SL, (1) 7/8" SH
M	(1) 1 1/4" Masterlink
S	Swivel

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UFO-2
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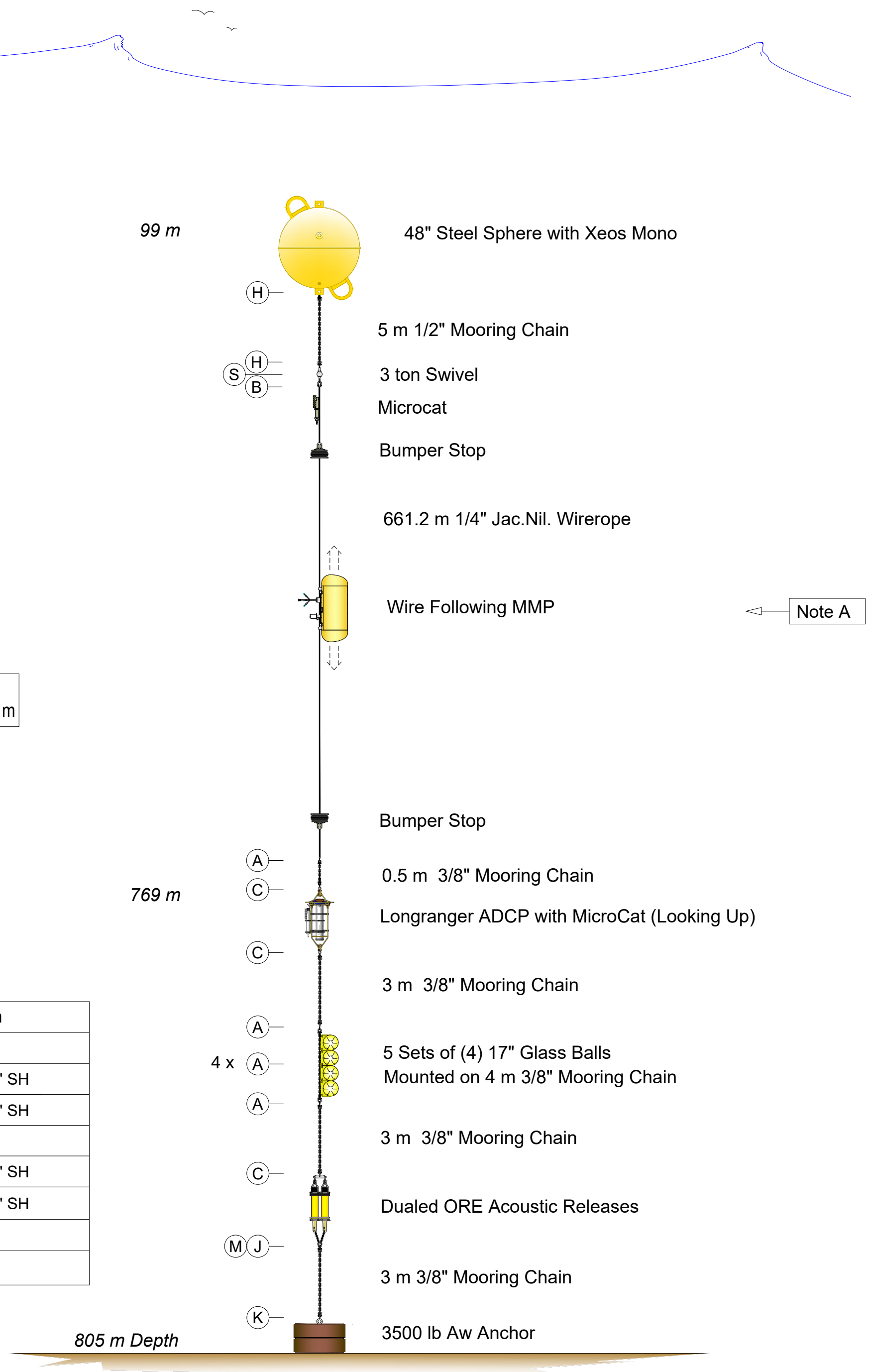
file: Pickart_UFO
date: 10/18/2024



Note A
Profile Depth Interval = 107 m to 760 m

Hardware Required (per mooring without spares)	
(18)	1/2" Anchor Shackle (SH)
(8)	5/8" Anchor Shackle (SH)
(3)	3/4" Anchor Shackle (SH)
(2)	7/8" Anchor Shackle
(16)	5/8" Sling Link (SL)
1	1-1/4" Master Link
1	3-ton Swivel

Hardware Designation	
A	(2) 1/2" SH, (1) 5/8" SL
B	(1) 1/2" SH, (1) 5/8" SL, (1) 5/8" SH
C	(1) 1/2" SH, (1) 5/8" SL, (1) 3/4" SH
H	(2) 5/8" SH, (1) 5/8" SL
J	(1) 5/8" SH, (1) 5/8" SL, (1) 7/8" SH
K	(1) 5/8" SH, (2) 5/8" SL, (1) 7/8" SH
M	(1) 1 1/4" Masterlink
S	Swivel

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UFO-3
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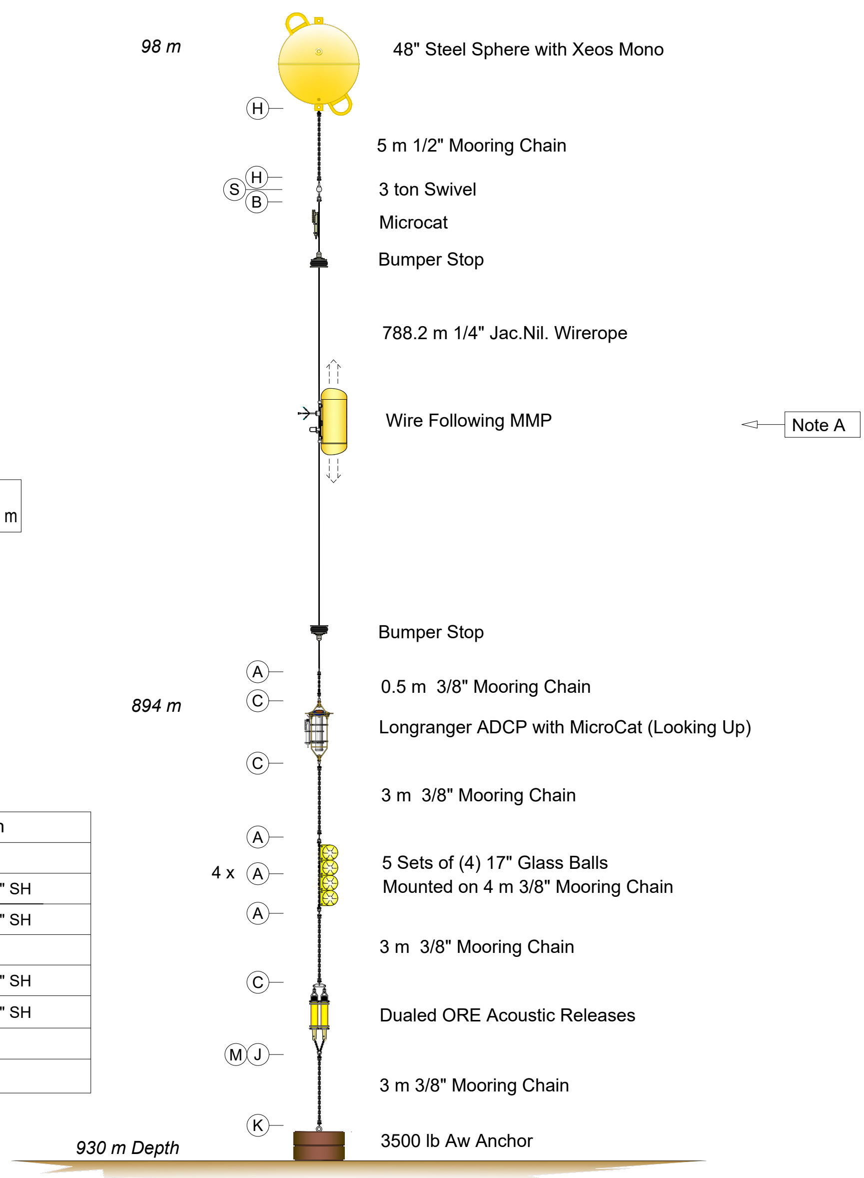
file: Pickart_UFO	date: 10/18/2024



Note A
Profile Depth Interval = 105 m to 885 m

Hardware Required (per mooring without spares)	
(18)	1/2" Anchor Shackle (SH)
(8)	5/8" Anchor Shackle (SH)
(3)	3/4" Anchor Shackle (SH)
(2)	7/8" Anchor Shackle
(16)	5/8" Sling Link (SL)
1	1-1/4" Master Link
1	3-ton Swivel

Hardware Designation	
A	(2) 1/2" SH, (1) 5/8" SL
B	(1) 1/2" SH, (1) 5/8" SL, (1) 5/8" SH
C	(1) 1/2" SH, (1) 5/8" SL, (1) 3/4" SH
H	(2) 5/8" SH, (1) 5/8" SL
J	(1) 5/8" SH, (1) 5/8" SL, (1) 7/8" SH
K	(1) 5/8" SH, (2) 5/8" SL, (1) 7/8" SH
M	(1) 1 1/4" Masterlink
S	Swivel

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UFO-4
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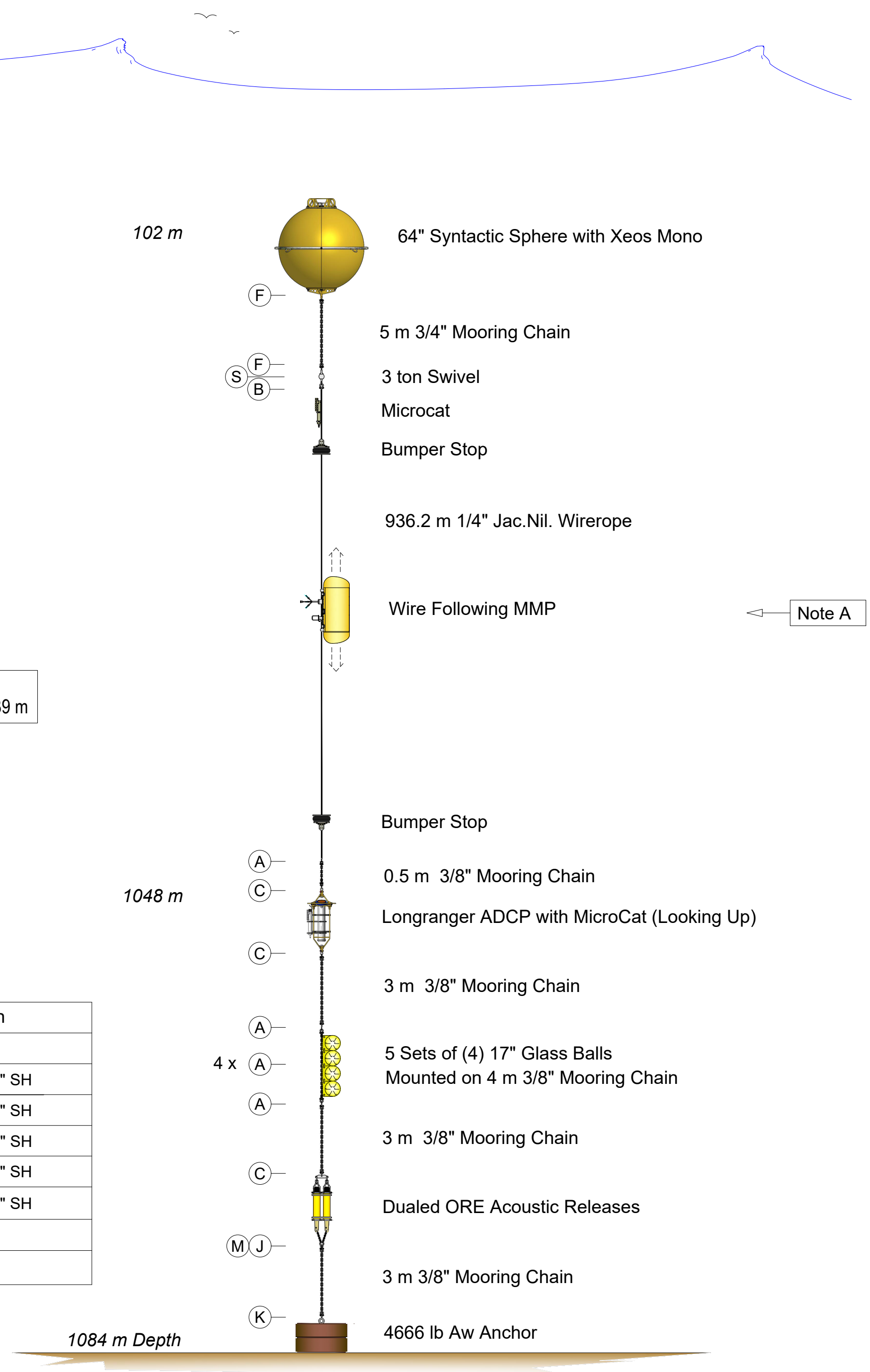

Note A
Profile Depth Interval = 109 m to 1039 m

Hardware Required (per mooring without spares)	
(20)	1/2" Anchor Shackle (SH)
(6)	5/8" Anchor Shackle (SH)
(5)	3/4" Anchor Shackle (SH)
(2)	7/8" Anchor Shackle
(17)	5/8" Sling Link (SL)
1	1-1/4" Master Link
1	3-ton Swivel

Hardware Designation	
A	(2) 1/2" SH, (1) 5/8" SL
B	(1) 1/2" SH, (1) 5/8" SL, (1) 5/8" SH
C	(1) 1/2" SH, (1) 5/8" SL, (1) 3/4" SH
F	(1) 5/8" SH, (1) 5/8" SL, (1) 3/4" SH
J	(1) 5/8" SH, (1) 5/8" SL, (1) 7/8" SH
K	(1) 5/8" SH, (2) 5/8" SL, (1) 7/8" SH
M	(1) 1 1/4" Masterlink
S	Swivel

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UFO-5
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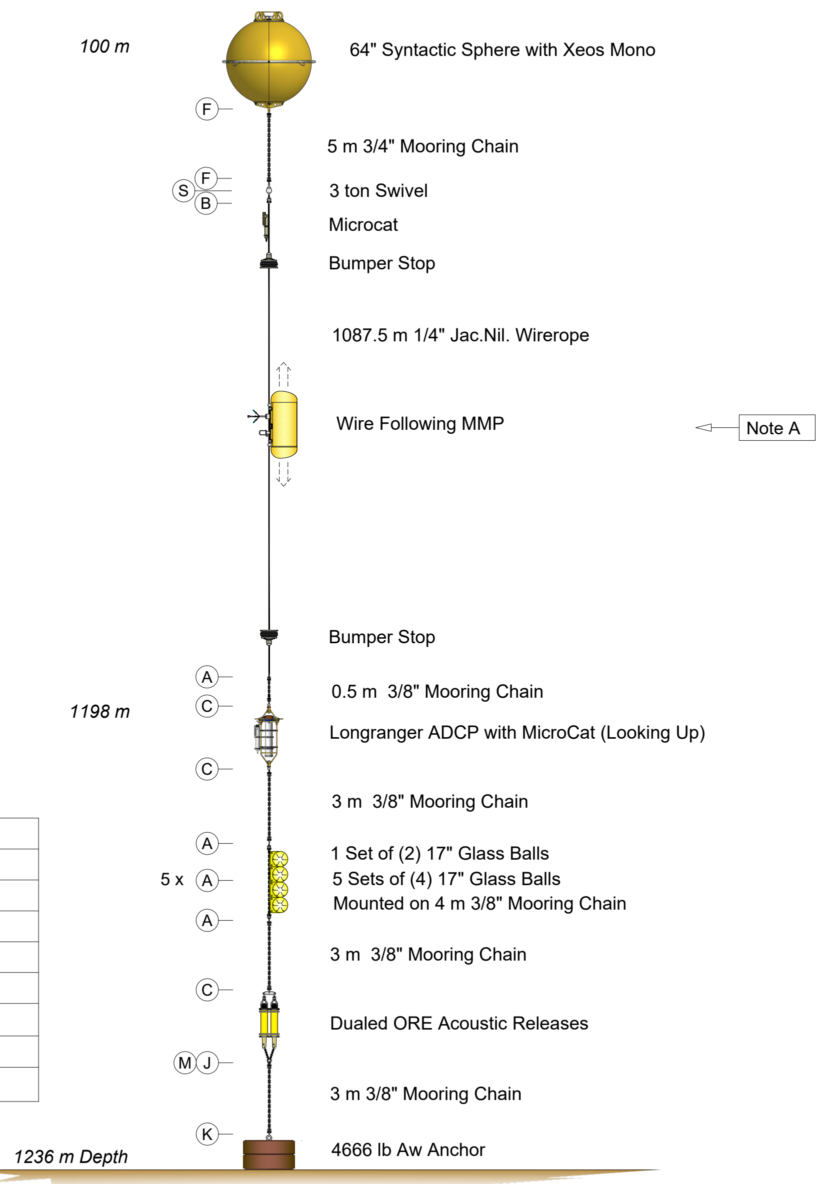
Woods Hole Oceanographic Institution
designed by John Kemp, drawn by Jim Ryder
file: Pickart_UFO date: 10/18/2024

Note A
Profile Depth Interval = 107 m to 1189 m

Hardware Required (per mooring without spares)	
(20)	1/2" Anchor Shackle (SH)
(6)	5/8" Anchor Shackle (SH)
(5)	3/4" Anchor Shackle (SH)
(2)	7/8" Anchor Shackle
(17)	5/8" Sling Link (SL)
1	1-1/4" Master Link
1	3-ton Swivel

Hardware Designation	
A	(2) 1/2" SH, (1) 5/8" SL
B	(1) 1/2" SH, (1) 5/8" SL, (1) 5/8" SH
C	(1) 1/2" SH, (1) 5/8" SL, (1) 3/4" SH
F	(1) 5/8" SH, (1) 5/8" SL, (1) 3/4" SH
J	(1) 5/8" SH, (1) 5/8" SL, (1) 7/8" SH
K	(1) 5/8" SH, (2) 5/8" SL, (1) 7/8" SH
M	(1) 1 1/4" Masterlink
S	Swivel



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UFO-6
As Deployed

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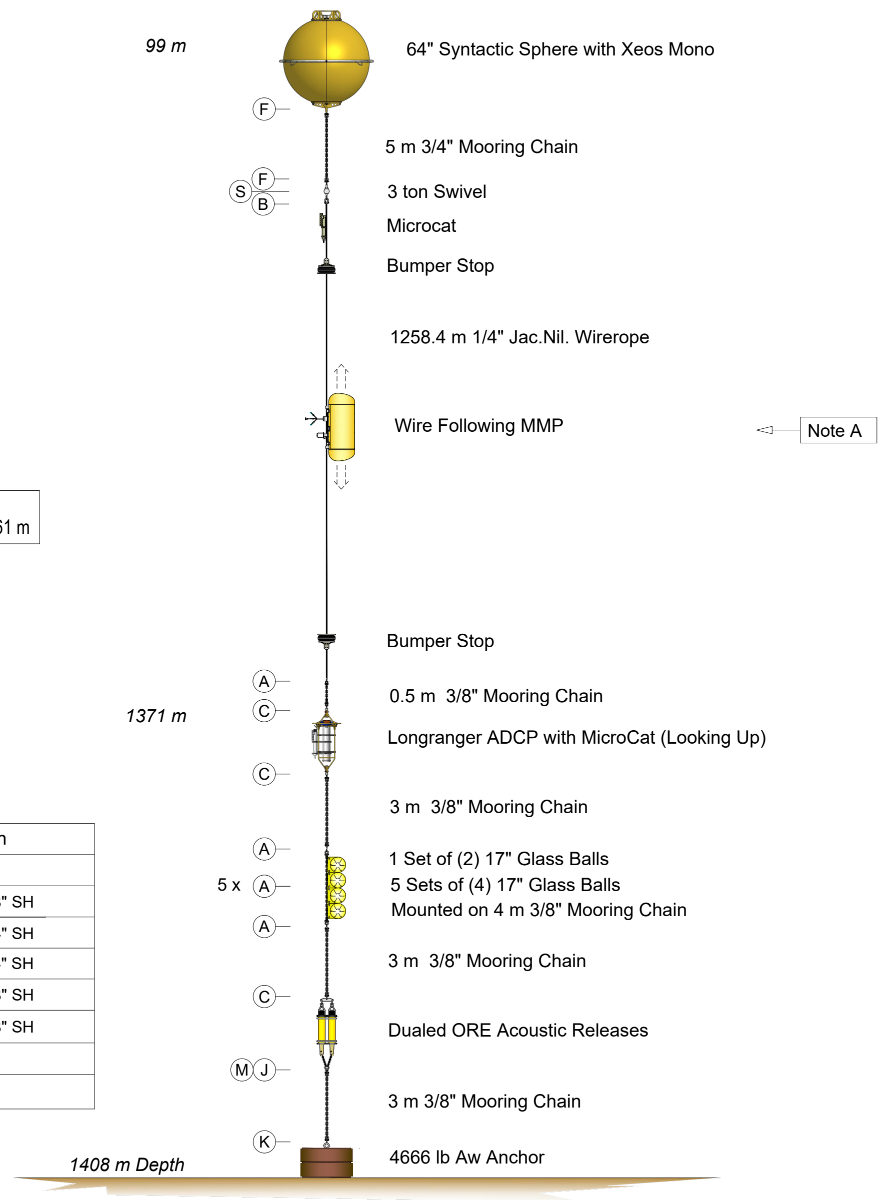
file: Pickart_UFO | date: 10/18/2024



Note A
Profile Depth Interval = 108 m to 1361 m

Hardware Required (per mooring without spares)	
(20)	1/2" Anchor Shackle (SH)
(6)	5/8" Anchor Shackle (SH)
(5)	3/4" Anchor Shackle (SH)
(2)	7/8" Anchor Shackle
(17)	5/8" Sling Link (SL)
1	1-1/4" Master Link
1	3-ton Swivel

Hardware Designation	
A	(2) 1/2" SH, (1) 5/8" SL
B	(1) 1/2" SH, (1) 5/8" SL, (1) 5/8" SH
C	(1) 1/2" SH, (1) 5/8" SL, (1) 3/4" SH
F	(1) 5/8" SH, (1) 5/8" SL, (1) 3/4" SH
J	(1) 5/8" SH, (1) 5/8" SL, (1) 7/8" SH
K	(1) 5/8" SH, (2) 5/8" SL, (1) 7/8" SH
M	(1) 1 1/4" Masterlink
S	Swivel

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UFO-7
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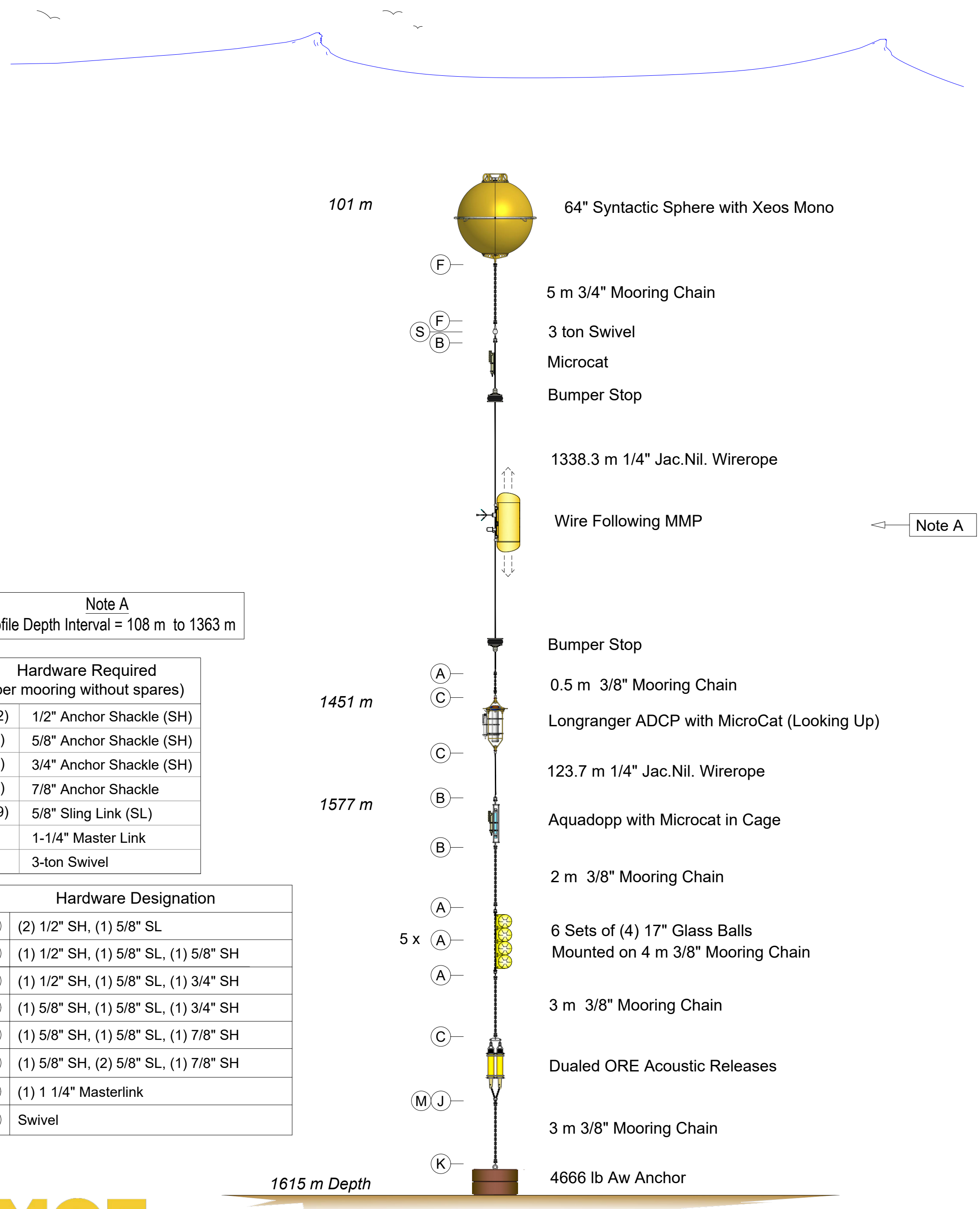
file: Pickart_UFO date: 10/18/2024



Note A
Profile Depth Interval = 108 m to 1363 m

Hardware Required (per mooring without spares)	
(22)	1/2" Anchor Shackle (SH)
(8)	5/8" Anchor Shackle (SH)
(5)	3/4" Anchor Shackle (SH)
(2)	7/8" Anchor Shackle
(19)	5/8" Sling Link (SL)
1	1-1/4" Master Link
1	3-ton Swivel

Hardware Designation	
A	(2) 1/2" SH, (1) 5/8" SL
B	(1) 1/2" SH, (1) 5/8" SL, (1) 5/8" SH
C	(1) 1/2" SH, (1) 5/8" SL, (1) 3/4" SH
F	(1) 5/8" SH, (1) 5/8" SL, (1) 3/4" SH
J	(1) 5/8" SH, (1) 5/8" SL, (1) 7/8" SH
K	(1) 5/8" SH, (2) 5/8" SL, (1) 7/8" SH
M	(1) 1 1/4" Masterlink
S	Swivel

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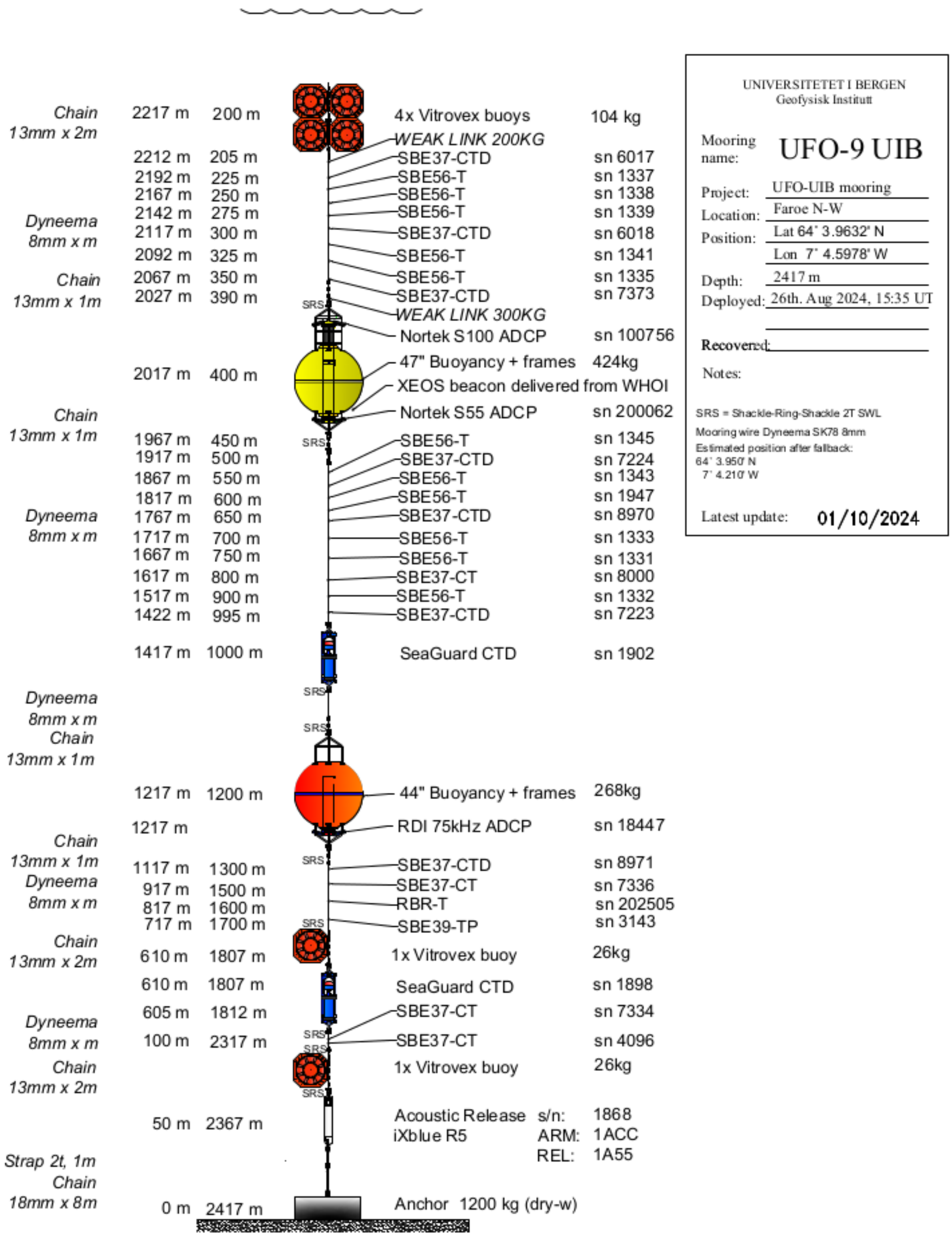
UFO-8
As Deployed

Woods Hole Oceanographic Institution	
designed by John Kemp, drawn by Jim Ryder	
file: Pickart_UFO	date: 10/18/2024



Chain 13mm x 2m
2217 m 200 m
4x Vitrovex buoys 104 kg
WEAK LINK 200KG
2212 m 205 m SBE37-CTD sn 6017
2192 m 225 m SBE56-T sn 1337
2167 m 250 m SBE56-T sn 1338
2142 m 275 m SBE56-T sn 1339
Dyneema 8mm x m
2117 m 300 m SBE37-CTD sn 6018
2092 m 325 m SBE56-T sn 1341
Chain 13mm x 1m
2067 m 350 m SBE56-T sn 1335
2027 m 390 m SBE37-CTD sn 7373
SRS
WEAK LINK 300KG
Nortek S100 ADCP sn 100756
2017 m 400 m
47" Buoyancy + frames 424kg
XEOS beacon delivered from WHOI
Nortek S55 ADCP sn 200062
Chain 13mm x 1m
SRS
1967 m 450 m SBE56-T sn 1345
1917 m 500 m SBE37-CTD sn 7224
1867 m 550 m SBE56-T sn 1343
1817 m 600 m SBE56-T sn 1947
Dyneema 8mm x m
1767 m 650 m SBE37-CTD sn 8970
1717 m 700 m SBE56-T sn 1333
1667 m 750 m SBE56-T sn 1331
1617 m 800 m SBE37-CT sn 8000
1517 m 900 m SBE56-T sn 1332
1422 m 995 m SBE37-CTD sn 7223
1417 m 1000 m SeaGuard CTD sn 1902
SRS
Dyneema 8mm x m
Chain 13mm x 1m
SRS
1217 m 1200 m 44" Buoyancy + frames 268kg
1217 m RDI 75kHz ADCP sn 18447
Chain 13mm x 1m
SRS
1117 m 1300 m SBE37-CTD sn 8971
Dyneema 8mm x m
917 m 1500 m SBE37-CT sn 7336
817 m 1600 m RBR-T sn 202505
717 m 1700 m SBE39-TP sn 3143
SRS
Chain 13mm x 2m
610 m 1807 m 1x Vitrovex buoy 26kg
610 m 1807 m SeaGuard CTD sn 1898
Dyneema 8mm x m
605 m 1812 m SBE37-CT sn 7334
SRS
100 m 2317 m SBE37-CT sn 4096
SRS
Chain 13mm x 2m
1x Vitrovex buoy 26kg
SRS
50 m 2367 m
Acoustic Release s/n: 1868
iXblue R5 ARM: 1ACC
REL: 1A55
Strap 2t, 1m
Chain 18mm x 8m
0 m 2417 m Anchor 1200 kg (dry-w)
UNIVERSITETET I BERGEN
Geofysisk Institutt
Mooring name: UFO-9 UIB
Project: UFO-UIB mooring
Location: Faroe N-W
Position: Lat 64° 3.9632' N
Lon 7° 4.5978' W
Depth: 2417 m
Deployed: 26th. Aug 2024, 15:35 UT
Recovered:
Notes:
SRS = Shackle-Ring-Shackle 2T SWL
Mooring wire Dyneema SK78 8mm
Estimated position after fallback:
64° 3.950' N
7° 4.210' W
Latest update: 01/10/2024