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Reports on Polar and Marine Research

The Expedition PS142 of the Research Vessel POLARSTERN to the Atlantic Ocean in 2024

Edited by

Simon Dreutter
with contributions of the participants

HELMHOLTZ

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(Foto: Simon Dreutter, AWI)

Cover: Sunset over the Atlantic Ocean
(Photo: Simon Dreutter, AWI)

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PS142

16 April 2024 – 13 May 2024

Walvis Bay – Bremerhaven

Chief scientist
Simon Dreutter

Coordinator
Ingo Schewe

Contents

1. ÜBERBLICK UND EXPEDITIONSVERLAUF

Simon Dreutter DE.AWI

Der Fahrtabschnitt PS142 war der letzte Abschnitt der antarktischen Forschungs-Saison 2023/24 und diente neben dem Forschungsprogramm dazu, *Polarstern* zurück nach Bremerhaven zu überführen. Die Reise startete am 16.04.2024 in Walvis Bay und endete am 13.05.2024 in Bremerhaven (Abb. 1.1). Am 03.05.2024 wurde ein kurzer Zwischenstopp vor Las Palmas eingelegt.

Während PS142 wurden folgende Messungen und Tätigkeiten durchgeführt:

- Mit den schiffsinternen hydroakustischen Systemen wurde auf nahezu der gesamten Strecke ein Streifen Meeresbodentopographie bathymetrisch vermessen. Die Gesamt-Fahrtzeit von vier Wochen umfasste einige Stunden Stationszeit für die Wasserschall-Kalibration der Echolotsysteme mittels mit der Durchführung von CTD-Stationen.
- Bei den täglichen CTD-Stationen wurden Wasserproben aus verschiedenen Tiefen zur Untersuchung von Coccolithophoren genommen. Wenn keine Station möglich war, wurden zusätzlich Proben über Reinseewasser Pumpe genommen.
- Es wurden tägliche Wetterbeobachtungen und -vorhersagen vom Deutschen Wetterdienst durchgeführt.
- Im ersten Abschnitt bis Las Palmas wurden weitreichende Wartungsarbeiten an der Schiffs-IT vorgenommen.

SUMMARY AND ITINERARY

The expedition PS142 was the last leg of the Antarctic season 2023/24 and, next to the scientific programme, did return *Polarstern* to its home port Bremerhaven. The trip started in Walvis Bay on 16 April 2024 and ended on 13 May 2024 in Bremerhaven (Fig. 1.1) with a short stopover in Las Palmas on 03 May 2024.

During PS142 the following measurements and acivities were carried out:

- The ship's own hydroacoustic systems were used to bathymetrically survey a strip of seabed topography along almost the entire route. The total cruise time of four weeks included several hours of station time for the water sound speed calibration of the echo sounder systems by means of CTD stations.

- At the daily CTD stations, water samples were taken from various depths to examine coccolithophores. If no station was possible, additional samples were taken via the ship's seawater in-take.
- Daily weather observations and forecasts were carried out by the German Weather Service.
- On the first leg up to Las Palmas, extensive maintenance work was carried out on the ship's IT systems.

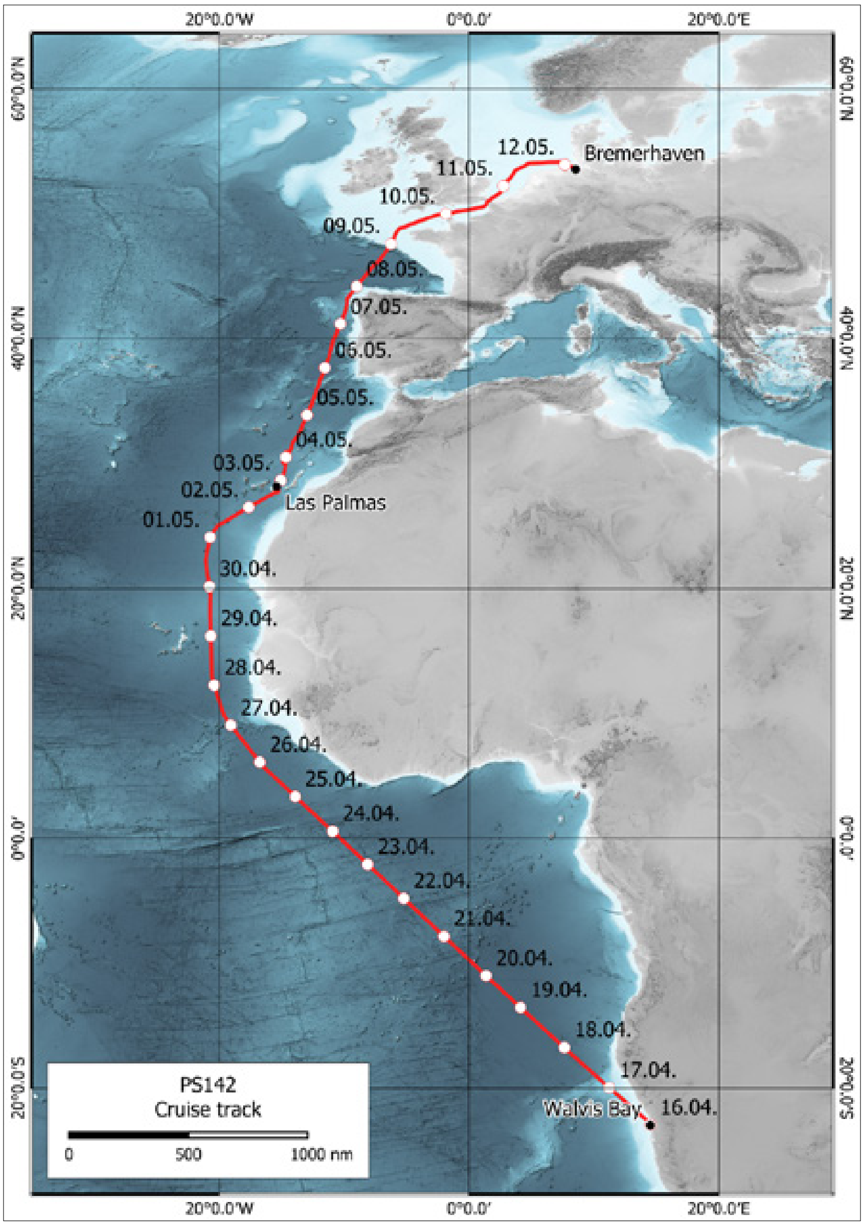

Abb. 1.1: Fahrtverlauf der Expedition PS142 von Walvis Bay – Bremerhaven. Siehe https://doi.pangaea.de/10.1594/PANGAEA.971668 für eine Darstellung des Master tracks in Verbindung mit der Stationsliste für PS142.

Fig. 1.1: Cruise track of expedition PS142 from Walvis Bay – Bremerhaven. See https://doi.pangaea.de/10.1594/PANGAEA.971668 to display the master track in conjunction with the station list for PS142.

WEATHER CONDITIONS DURING PS142

Anne Wiese DE.DWD

Polarstern departed from Walvis Bay (Namibia) on 16 April 2024 in the afternoon. Between a shallow high to the west of South Africa and a trough directed southwards from Central Africa along the western African coast, the route was right of the beginning in the south-easterly trade winds, which were mostly moderate to fresh. The sea state increased to a significant wave height of 2 metres within the first two days, with one component from the wind direction and another component from south to southwest, which originated from deep lows in the southern Atlantic. From 19 April, the south-easterly trade winds remained mostly moderate and the significant wave height was mostly 1.5 metres and only occasionally rose to 2 metres. The high off the South African coast weakened as the days progressed. A new high moved eastwards from the Brazilian coast and became an extensive subtropical high. As *Polarstern* progressed northwards, the cloudiness gradually increased and the first showers and lightning appeared in the area on 22 April.

During the night to 24 April, the wind continued to die down and *Polarstern* entered the ITCZ, which lay quite far to the south. At the time, the ITCZ was positioned just north of the equator, stretching from Liberia in West Africa to northern Brazil and temporarily shifting slightly northwards in the eastern part. On 24 April, a shower passed directly over *Polarstern*. Visibility dropped significantly due to the rain, the temperature temporarily fell from 29°C to 25°C and gusts of up to 8 Bft occurred. At the end, there was a brief intermittent thunderstorm. Otherwise, it was mostly light winds in the ITCZ and lightning was repeated visible during the night. The swell was mostly between 1 and 1.5 metres, initially from southerly directions, just north of the equator, the component from the north was added, which increased further as *Polarstern* progressed north, while the component from southerly directions became weaker.

During the night to 26 April, the wind shifted to northerly directions and increased to around 3 Bft. Between the low-pressure trough over Central Africa, which barely changed, and another low over Algeria, which was initially stationary and later moved north-eastwards, as well as a high, which was initially north-west of the Azores and then moved south-eastwards towards Madeira, the wind increased continuously until the peak was reached on 30 April with around 7 Bft from the north-east and 3.5 to 4 metre significant wave height. Afterwards, the north-easterly trade wind slowly decreased to around 5 Bft and the significant wave height also decreased again to 2 to 2.5 metres. As it approached the Canary Islands on the night of 3 May, *Polarstern* passed through both the lee of Gran Canaria and the jet between the islands, causing the wind to increase to 6 to 7 Bft at times.

As the high remained fairly stationary near Madeira, the wind north of the Canary Islands remained around 5 Bft from the north-east. The wind and waves only began to decrease further as *Polarstern* approached the centre of the high during the night to 5 May. The minimum was then reached in the morning with around 2 Bft. The main direction of the swell turned to northwest to west and was mostly around 1.5 metres. Afterwards, the wind turned to the north-west and increased again to around 4 Bft. The high began to move north-eastwards during the night of 6 May, which brought *Polarstern* to the eastern flank of the high and the wind slowly shifted back to north to north-east. A ridge as far as Madeira remained. On its eastern flank, the route then lay in a mostly moderate to fresh north to north-easterly wind. With the approach to Cape Finisterre, the wind picked up and reached its peak on the morning of 8 May with around 7 Bft. At the same time, the wind shifted to the east. In addition, the wind sea increased, resulting in a significant wave height of 3 metres. The high-pressure system reached England on 8 May and subsequently moved only slowly further eastwards, so that the route was located on its south-western flank. With progression northwards, the wind dropped to around 5 Bft and the waves to 1 to 1.5 metres. With the approach of Ouessant, the wind temporarily dropped to 3 Bft in the lee of the Breton peninsula. On the northern side, the wind then increased to 5 to 6 Bft due to the Cape effect. Afterwards, the wind oscillated between around 4 and around 5 Bft from easterly directions and the significant wave height was less than 1 metre. In the English Channel, visibility became hazy at times.

On the approach to Bremerhaven, the high was located over the south-eastern Baltic Sea and a trough had formed, starting from a low over the Irminger Sea, had formed reaching as far as France. In between, the last part of the route was then in an easterly to south-easterly wind blowing at around 5 Bft. In the late morning of 12 May there was temporary fog over the East Frisian Islands. *Polarstern* arrived in Bremerhaven (Germany) on the evening of 12 May.

2. BATHYMETRIC UNDERWAY MEASUREMENTS

Simon Dreutter[1], Annie Lemire[2]
not on board: Boris Dorschel[1]

[1]DE.AWI
[2]DE.UNI-BREMEN

Grant-No. AWI_PS142_01

Objectives

Accurate knowledge of the seafloor topography, hence high-resolution bathymetry data, is key basic information necessary to understand many marine processes. It is of particular importance for the interpretation of scientific data in a spatial context. Bathymetry, or geomorphology, is a basic parameter for the understanding of the general geological setting of an area and geological processes such as erosion, sediment transport and deposition. Even information on tectonic processes can be inferred from bathymetry. Supplementing the bathymetric data, high-resolution sub-bottom profiler data of the top 10s of meters below the seabed provide information of the sediment architecture and the lateral extension of sediment successions. This can be used to study depositional environments on larger scales in terms of space and time, of which the uppermost sediments may be sampled.

While the bathymetric maps of the world give the impression of a detailed knowledge of worldwide seafloor topography, most of the world's ocean floor remains unmapped by hydroacoustic systems. In these areas, bathymetry is modelled from satellite altimetry with a corresponding low resolution. Bathymetry derived from Satellite-altimetry therefore lacks the necessary resolution to resolve small- to meso-scale geomorphological features (e.g., sediment waves, glaciogenic features and small seamounts). Ship-borne multibeam data provide bathymetry information in a resolution that is sufficient to resolve those features.

Therefore, the main tasks of the bathymetry/geophysics group on board *Polarstern* during PS142 were:

- Collection of bathymetric data, including calibration and correction of the data with respect to environmental circumstances (sound velocity, systematic errors in bottom detection, etc.)
- Post processing and cleaning of the data
- Data management for on-site map creation
- Collection of sound velocity data

Work at sea

Technical description

During the PS142 cruise, the bathymetric surveys were conducted with the hull-mounted multibeam echosounder (MBES) Teledyne Reson HYDROSWEEP DS3. The HYDROSWEEP is a deep-water system for continuous mapping with the full swath potential. It operates on a frequency of ~14 kHz. On *Polarstern*, the MBES transducer arrays are arranged in a

Mills cross configuration of 3 m (transmit unit) by 3 m (receive unit). The combined motion, position (Trimble GNSS), and time data comes from an iXBlue Hydrins system and the signal is directly transferred into the Control Module (CM) of the MBES to carry out real-time motion compensation in Pitch, Roll and Yaw. With a combination of phase and amplitude detection algorithms the CM computes the water depth from the returning backscatter signal. The system can cover a sector of up to 140° with 70° per side. In the deep sea, an angle of ~50° to both sides could be achieved.

Data acquisition and processing

Data acquisition was carried out along the entire cruise track between Walvis Bay and Bremerhaven, with exception of the EEZs of Namibia, Spain, Belgium, Netherlands and Germany. The MBES was operated with Sonar UI and for online data visualization, Teledyne PDS was used. The collected bathymetry was stored in S7K raw files. Subsequent data processing was performed using Caris HIPS and SIPS. For generating maps, the data were exported to Quantum GIS in the GeoTIFF raster format.

Sound velocity profiles

For best survey results with correct depths, frequent CTD (Conductivity Temperature Depth) casts were performed by the Bathymetry group, and were used to measure the water sound velocity in different depths. This is essential, as the acoustic signal travels down the water column from the transducer to the seafloor and back to the surface through several different layers of water masses with each a different sound velocity. The sound velocity (SV) is influenced by density and compressibility, both depending on pressure, temperature and salinity. Wrong or outdated sound velocity profiles lead to refraction errors and reduced data quality.

The CTD measures conductivity, temperature, and depth in the water column while the ship is on station. From these parameters, the sound velocity is calculated.

The sound velocity profiles obtained by the CTD were immediately processed and applied within the MBES for correct beamforming during the survey.

Additionally, these profiles were combined/extended with WOA18 (World Ocean Atlas 2018) data to create full ocean depth SV profiles.

Stations

The Hydrosweep and CTD stations are listed in Table 2.1.

Tab. 2.1: List of bathymetry related stations during PS142

Station Number	Description	Time	Latitude	Longitude
PS142_0_ Underway-28	Multibeam underway survey	Start: 2024-04-18 07:00 End: 2024-05-09 18:00	Start: 17° 19.903' S End: 48° 32.958' N	Start: 008° 14.216' E End: 005° 47.799' W
PS142_1-1	CTD	2024-04-18 11:00	16° 45.929' S	007° 37.170' E
PS142_2-1	CTD	2024-04-19 11:00	13° 33.915' S	004° 07.205' E
PS142_3-1	CTD	2024-04-20 10:59	11° 01.104' S	001° 21.268' E
PS142_4-1	CTD	2024-04-21 12:00	07° 51.835' S	002° 01.197' W
PS142_5-1	CTD	2024-04-22 12:00	04° 49.852' S	005° 14.442' W
PS142_6-1	CTD	2024-04-23 12:00	02° 06.029' S	008° 07.602' W

Station Number	Description	Time	Latitude	Longitude
PS142_7-1	CTD	2024-04-24 12:00	00° 33.125’ N	010° 56.819’ W
PS142_8-1	CTD	2024-04-25 11:58	03° 19.223’ N	013° 55.432’ W
PS142_9-1	CTD	2024-04-26 12:00	06° 04.546’ N	016° 46.221’ W
PS142_10-1	CTD	2024-04-27 12:00	09° 02.449’ N	019° 06.360’ W
PS142_11-1	CTD	2024-04-28 12:00	12° 14.305’ N	020° 25.181’ W
PS142_12-1	CTD	2024-04-29 12:00	16° 10.441’ N	020° 40.988’ W
PS142_13-1	CTD	2024-04-30 12:00	20° 08.728’ N	020° 48.355’ W
PS142_14-1	CTD	2024-05-01 11:59	24° 05.213’ N	020° 44.913’ W
PS142_15-1	CTD	2024-05-03 17:26	29° 31.936’ N	014° 46.894’ W
PS142_16-1	CTD	2024-05-04 11:59	30° 29.527’ N	014° 41.085’ W
PS142_17-1	CTD	2024-05-05 12:00	33° 51.955’ N	012° 59.061’ W
PS142_18-1	CTD	2024-05-06 12:00	37° 38.736’ N	011° 33.229’ W
PS142_19-1	CTD	2024-05-07 11:59	41° 09.698’ N	010° 18.327’ W
PS142_20-1	CTD	2024-05-08 11:00	44° 06.100’ N	009° 03.316’ W

Preliminary results

During 21 days, bathymetric data was surveyed along the cruise track by the swath bathymetry system. Figure 2.1 shows the generated bathymetry grid over the Atlantic.

Data management

Geophysical and oceanographic data will be archived, published and disseminated according to international standards by the World Data Center PANGAEA Data Publisher for Earth & Environmental Science (https://www.pangaea.de) within two years after the end of the cruise at the latest. By default, the CC-BY license will be applied. Furthermore, bathymetric data will be provided to the Nippon Foundation – GEBCO Seabed 2030 Project.

This expedition is supported by the Helmholtz Research Programme “Changing Earth – Sustaining our Future” Topic 2, Subtopic 3 Sea Level Change.

In all publications based on this expedition, the **Grant No. AWI_ PS142_01** will be quoted and the following publication will be cited:

Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung (2017) Polar Research and Supply Vessel POLARSTERN Operated by the Alfred-Wegener-Institute. Journal of large-scale research facilities, 3, A119. http://dx.doi.org/10.17815/jlsrf-3-163.

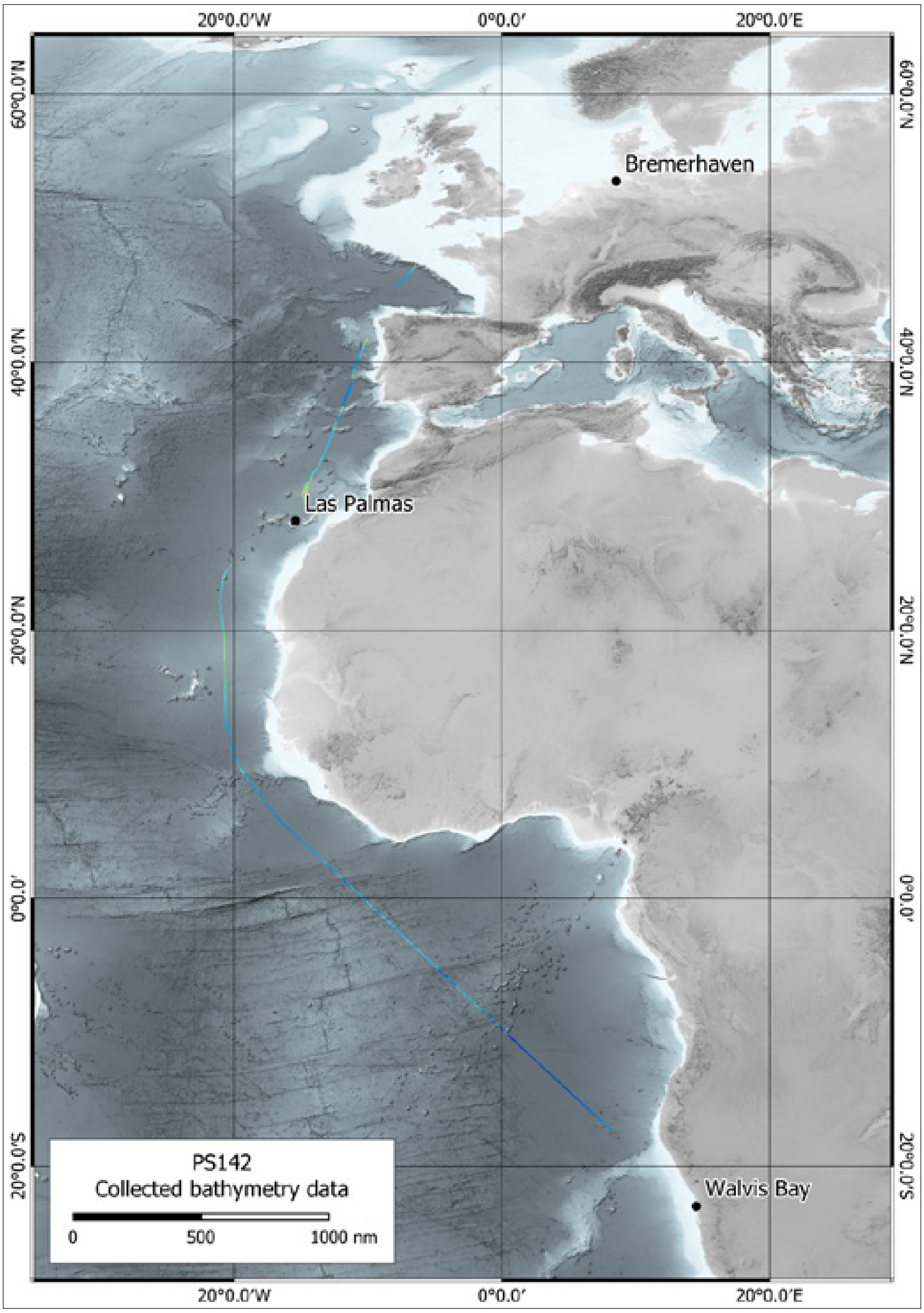

Fig. 2.1: Overview on bathymetry data collected during PS142

3. CAPTURING DIVERSITY OF COCCOLITHOPHORES THROUGH SINGLE CELL GENOMICS

Raphael Gollnisch[1]

[1]UK.OXF

Grant-No. AWI_PS142_02

Outline

Marine phytoplankton are responsible for producing half of our planet's organic matter and oxygen. Despite their significance, surprisingly little is known about their demographic history and the population genetic processes that underlie their evolution. This project aims to advance our understanding of evolutionary processes in extremely large plankton populations by building on recent plankton evolution research. The project will focus specifically on coccolithophores, which are fundamental components of the marine carbon cycle. It aims to investigate the demography and evolutionary history of coccolithophores based on genomic analysis of extant species. The large quantities of DNA required for sequencing are typically obtained through laboratory culture of monoclonal strains of unicellular algae. However, only a small fraction of coccolithophore species have been successfully grown in culture. Culturing strains of *Geophyrocapsa* species is well established, but the diversity of coccolithophores beyond these genera is currently underrepresented in culture collections. In this project, single-cell genomics will be employed to circumvent the existing culturing bias in coccolithophores.

Objectives

The objective of this project was to sample coccolithophores and to isolate single cells, aiming at uncultured species in particular. Samples were collected to cover a wide geographic range (see Fig. 3.1) in diversity of coccolithophores. The isolated single cells will then be used for whole genome amplification and single-cell genomic analysis of the demography and evolutionary history of uncultured coccolithophores.

Work at sea

Surface seawater samples were collected using Niskin bottles (rosette water sampler) at 20 stations and via the seawater in-take membrane pump at two further stations (see Tab. 3.1 for details) to characterize the phytoplankton assemblage and to isolate single cells of coccolithophores. The samples were concentrated and preserved for isolation of single coccolithophore cells (single-cell genome sequencing) and filtered for metagenome sequencing as well as SEM imaging.

Seawater samples for single cell isolation were concentrated through tangential flow filtration and preserved. Single cells of coccolithophores will be isolated from the concentrated samples by micropipetting and using a microscope, documenting isolated cells by microscopy images during isolation to later link individual genotypes to morphotypes. The single-cell isolates will be used for whole genome amplification and sequencing to produce single amplified genomes. Seawater samples for SEM imaging to characterize the species assemblage in the sample were vacuum filtered onto PC membrane filters and dried. Seawater samples for metagenome sequencing were vacuum filtered onto PC membrane filters and stored frozen for subsequent nucleic acid extraction and sequencing.

Tab. 3.1: List of water sampling stations during PS142

Station Number	Description	Time	Latitude	Longitude
PS142_1-1	CTD	2024-04-18 11:00	16° 45.929' S	007° 37.170' E
PS142_2-1	CTD	2024-04-19 11:00	13° 33.915' S	004° 07.205' E
PS142_3-1	CTD	2024-04-20 10:59	11° 01.104' S	001° 21.268' E
PS142_4-1	CTD	2024-04-21 12:00	07° 51.835' S	002° 01.197' W
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PS142_7-1	CTD	2024-04-24 12:00	00° 33.125' N	010° 56.819' W
PS142_8-1	CTD	2024-04-25 11:58	03° 19.223' N	013° 55.432' W
PS142_9-1	CTD	2024-04-26 12:00	06° 04.546' N	016° 46.221' W
PS142_10-1	CTD	2024-04-27 12:00	09° 02.449' N	019° 06.360' W
PS142_11-1	CTD	2024-04-28 12:00	12° 14.305' N	020° 25.181' W
PS142_12-1	CTD	2024-04-29 12:00	16° 10.441' N	020° 40.988' W
PS142_13-1	CTD	2024-04-30 12:00	20° 08.728' N	020° 48.355' W
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PS142_18-1	CTD	2024-05-06 12:00	37° 38.736' N	011° 33.229' W
PS142_19-1	CTD	2024-05-07 11:59	41° 09.698' N	010° 18.327' W
PS142_20-1	CTD	2024-05-08 11:00	44° 06.100' N	009° 03.316' W
PS142_21-1	Seawater Tap	2024-05-09 10:19	47° 19.319' N	006° 23.978' W
PS142_22-1	Seawater Tap	2024-05-10 13:52	50° 04.589' N	001° 23.342' W

Preliminary (expected) results

The project will provide insights into the genetic diversity of coccolithophores through single amplified genomes and metagenomes, with a focus on uncultured species. This will allow to study their demography and evolutionary history. Evolutionary genetic inference of the demographic history of coccolithophores in combination with paleontological records will improve our paleoclimatic understanding of the biological drivers of global climatic change.

Data management

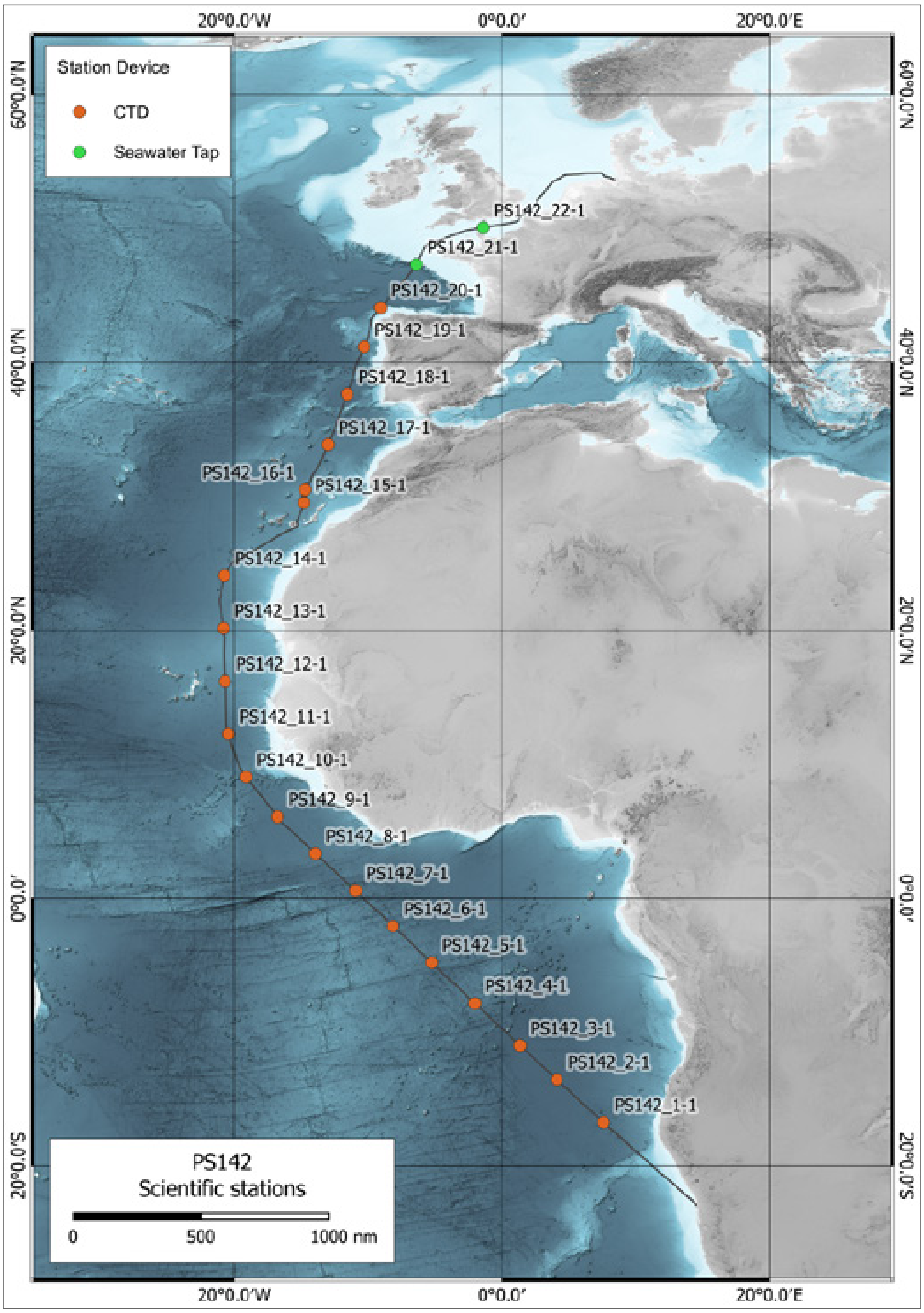
Environmental data will be archived, published, and disseminated according to international standards by the World Data Center PANGAEA Data Publisher for Earth & Environmental Science (https://www.pangaea.de) within two years after the end of the expedition at the latest. By default, the CC-BY license will be applied.

Molecular data (DNA and RNA data) will be archived, published, and disseminated within one of the repositories of the International Nucleotide Sequence Data Collaboration (INSDC, www.insdc.org) comprising of EMBL-EBI/ENA, GenBank and DDBJ).

Any other data will be submitted to an appropriate long-term archive that provides unique and stable identifiers for the datasets and allows open online access to the data.

In all publications based on this expedition, the **Grant No. AWI_PS142_02** will be quoted and the following publication will be cited:

Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung (2017) Polar Research and Supply Vessel POLARSTERN Operated by the Alfred-Wegener-Institute. Journal of large-scale research facilities, 3, A119. http://dx.doi.org/10.17815/jlsrf-3-163.



1.

Fig. 3.1: Overview on scientific sampling stations during PS142.

APPENDIX

A.1 TEILNEHMENDE INSTITUTE / PARTICIPATING INSTITUTES

A.2 FAHRTTEILNEHMER:INNEN / CRUISE PARTICIPANTS

A.3 SCHIFFSBESATZUNG / SHIP‘S CREW

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Crenan	Brieuc	DE.LAEISZ	Engineer	Logistics
Dreutter	Simon	DE.AWI	Technician	Geophysics
Immoor	Sebastian	DE.AWI	Technician	Logistics
Janssen	Inna	DE.WERUM	Engineer	Logistics
Lemire	Annie	DE.UNI-BREMEN	Student	Geophysics
Lensch	Norbert	DE.AWI	Technician	Geology
Gollnisch	Raphael	UK.OXF	Scientist	Biology
Riess	Felix	DE.LAEISZ	Inspector	Logistics
Rohleder	Christian	DE.DWD	Technician	Meteorology
Seidenstücker	Andreas	DE.SYSTEMA	Engineer	Logistics
Wiese	Anne	DE.DWD	Scientist	Meteorology

A.3 SCHIFFSBESATZUNG / SHIP'S CREW

No.	Name	Position
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3	Eckenfels, Hannes	1. NO Ladung
4	Weiß, Daniel	2. NO
5	Heisterkamp, Ole Louca	2. NO
6	Guba, Klaus	Schiffsarzt
7	Ziemann, Olaf Hermann August	LTO
8	Ehrke, Tom	2. TO
9	Krinfeld, Oleksandr	2. TO
10	Rusch, Torben	2. TO
11	Hofmann, Joerg Walter	Elektroniker Kommunikation
12	Schwedka, Thorsten	Elektroniker Labor
13	Frank, Gerhard Ansgar Leon	Elektroniker Brücke
14	Pommerencke, Bernd	Elektroniker Maschine
15	Krueger, Lars	Elektroniker Winde
16	Winter, Andreas	Elektroniker System
17	Zivanov, Stefan	Elektroniker zusätzlich (Einarbeitung)
18	Brueck, Sebastian	Bootsmann
19	Buchholz, Joscha	FA/Deck
20	Moeller, Falko	FA/Deck
21	Mahlmann, Oliver Karl-Heinz	FA/Deck
22	Schade, Tom	FA/Deck
23	Decker, Jens	FA/Deck
24	Kryszkiewicz, Maciej Waldemar	FA/Deck
25	Siemon, Leon Anton	FA/Deck
26	Niebuhr, Tim	FA/Deck (AB)
27	Keller, Juergen Eugen	Zimmermann
28	Jassmann, Marvin	FA/Maschine
29	Probst, Lorenz	FA/Maschine
30	Buchholz, Karl Erik	FA/Maschine
31	Plehn, Marco Markus	Fitter/Storekeeper
32	Skrzipale, Mitja	1. Koch
33	Fehrenbach, Martina	Kochsmaat
34	Markowski, Jakub Karol	Kochsmaat
35	Witusch, Petra Gertrud Ramona	1. Stewardess

No.	Name	Position
36	Ilk, Romy	Stewardess/Krankenschwester
37	Stocker, Eileen Sigourney	Stewardess
38	Golla, Gerald	Steward
39	Shi, Wubo	Messe/Wäscherei
40	Chen, Jirong	Messe/Wäscherei
41	Chen, Quanlun	Messe/Wäscherei
42	Klett, Paul Onno Caspar Maria	Auszubildender Schiffsmechaniker
43	Schneider, Denise	Auszubildende Schiffsmechanikerin

A.4 STATIONSLISTE / STATION LIST PS142

Station list of expedition PS142 from Walvis Bay to Bremerhaven;
the list details the action log for all stations along the cruise track.

See https://www.pangaea.de/expeditions/events/PS142 to display the station (event) list for expedition PS142.
This version contains Uniform Resource Identifiers for all sensors listed under https://sensor.awi.de. See https://www.awi.de/en/about-us/service/computing-centre/data-flow-framework.html for further information about AWI's data flow framework from sensor observations to

Event label	Optional label	Date/Time	Latitude	Longitude	Depth [m]	Gear	Action	Comment
PS142_0_Underway-51		2024-04-16T14:41:39	-22.95029	14.49712	7,4	SWEAS	Station start	
PS142_0_Underway-51		2024-05-12T16:42:26	53.56408	8.55901	2,2	SWEAS	Station end	
PS142_0_Underway-28		2024-04-18T07:00:04	-17.33100	8.23669	4754,1	DS3	Station start	Profiles stopped within EEZ Spain; Event shows start/end point (date/time & coordinates) of first/last data record by Hydrosweep
PS142_0_Underway-28		2024-05-09T18:03:39	48.55730	-5.79260	111,9	DS3	Station end	Profiles stopped within EEZ Spain; Event shows start/end point (date/time & coordinates) of first/last data record by Hydrosweep
PS142_0_Underway-3		2024-04-18T07:07:11	-17.31441	8.21780	4758,3	ADCP	Station start	Profiles stopped within EEZ Spain
PS142_0_Underway-3		2024-05-11T07:18:29	51.51589	2.26362	21,7	ADCP	Station end	Profiles stopped within EEZ Spain
PS142_0_Underway-43		2024-04-18T07:12:53	-17.30069	8.20266	4768,5	TSG	Station start	Profiles stopped within EEZ Spain
PS142_0_Underway-43		2024-05-11T07:20:52	51.52104	2.27028	22,9	TSG	Station end	Profiles stopped within EEZ Spain

** Comments are limited to 130 characters. See* https://www.pangaea.de/expeditions/events/PS142 *to show full comments in conjunction with the station (event) list for expedition PS142*

Event label	Optional label	Date/Time	Latitude	Longitude	Depth [m]	Gear	Action	Comment
PS142_0_Underway-44		2024-04-18T07:13:13	-17.29992	8.20182	4769,6	TSG	Station start	Profiles stopped within EEZ Spain
PS142_0_Underway-44		2024-05-11T07:20:21	51.51989	2.26881	24,4	TSG	Station end	Profiles stopped within EEZ Spain
PS142_0_Underway-13		2024-04-18T07:39:14	-17.23736	8.13273	4891,8	FBOX	Station start	Profiles stopped within EEZ Spain
PS142_0_Underway-13		2024-05-11T07:19:09	51.51729	2.26545	23,9	FBOX	Station end	Profiles stopped within EEZ Spain
PS142_0_Underway-34		2024-04-18T07:41:36	-17.23173	8.12648	4892,2	pCO2	Station start	Profiles stopped within EEZ Spain
PS142_0_Underway-34		2024-05-11T07:19:52	51.51883	2.26746	25	pCO2	Station end	Profiles stopped within EEZ Spain
PS142_0_Underway-23		2024-04-18T07:44:16	-17.22539	8.11939	4895,5	MAG	Station start	Profiles stopped within EEZ Spain
PS142_0_Underway-23		2024-05-11T07:18:55	51.51680	2.26481	25,3	MAG	Station end	Profiles stopped within EEZ Spain
PS142_0_Underway-24		2024-04-18T07:45:28	-17.22250	8.11623	4894,3	GRAV	Station start	Profiles stopped within EEZ Spain
PS142_0_Underway-24		2024-05-11T07:18:49	51.51656	2.26449	24,4	GRAV	Station end	Profiles stopped within EEZ Spain
PS142_1-1		2024-04-18T11:42:17	-16.76564	7.61944	4968,6	CTD-RO	max depth	
PS142_2-1		2024-04-19T11:38:22	-13.56443	4.11976	5548,4	CTD-RO	max depth	
PS142_3-1		2024-04-20T11:39:56	-11.01894	1.35465	5610,5	CTD-RO	max depth	
PS142_4-1		2024-04-21T12:41:33	-7.86378	-2.01983	4449,8	CTD-RO	max depth	
PS142_5-1		2024-04-22T12:42:04	-4.83012	-5.24077	4534,1	CTD-RO	max depth	
PS142_6-1		2024-04-23T12:42:56	-2.10337	-8.13220	4561,9	CTD-RO	max depth	
PS142_7-1		2024-04-24T12:38:35	0.55510	-10.95417	4656,8	CTD-RO	max depth	
PS142_8-1		2024-04-25T12:40:04	3.32082	-13.92422	4729	CTD-RO	max depth	
PS142_9-1		2024-04-26T12:39:15	6.07700	-16.76744	4965,6	CTD-RO	max depth	
PS142_10-1		2024-04-27T12:44:03	9.03979	-19.10800	4637,2	CTD-RO	max depth	

Event label	Optional label	Date/Time	Latitude	Longitude	Depth [m]	Gear	Action	Comment
PS142_11-1		2024-04-28T12:47:53	12.23745	-20.42033	4839,9	CTD-RO	max depth	
PS142_12-1		2024-04-29T12:37:00	16.17252	-20.68439	3725,9	CTD-RO	max depth	
PS142_13-1		2024-04-30T12:42:48	20.14141	-20.81011	3757,6	CTD-RO	max depth	
PS142_14-1		2024-05-01T12:38:52	24.08627	-20.75146	4119,1	CTD-RO	max depth	
PS142_15-1		2024-05-03T18:00:06	29.53162	-14.78232	3509,2	CTD-RO	max depth	
PS142_16-1		2024-05-04T12:37:08	30.49237	-14.68497	3096,7	CTD-RO	max depth	
PS142_17-1		2024-05-05T12:37:56	33.86690	-12.98333	4441	CTD-RO	max depth	
PS142_18-1		2024-05-06T12:40:15	37.64666	-11.55304	5104,2	CTD-RO	max depth	
PS142_19-1		2024-05-07T12:42:06	41.16150	-10.30540	4036,3	CTD-RO	max depth	
PS142_20-1		2024-05-08T11:13:18	44.10206	-9.05591	955,9	CTD-RO	max depth	
PS142_21-1		2024-05-09T10:19:13	47.32198	-6.39964	957,3	TAP	max depth	sample with diaphragm pump
PS142_22-1		2024-05-10T13:52:45	50.07648	-1.38904	53,1	TAP	max depth	sample with diaphragm pump

** Comments are limited to 130 characters. See https://www.pangaea.de/expeditions/events/PS142 to show full comments in conjunction with the station (event) list for expedition PS142*

Abbreviation	**Method/Device**
ADCP	Acoustic Doppler Current Profiler
CTD-RO	CTD/Rosette
DS3	Swath-mapping system Atlas Hydrosweep DS-3
FBOX	FerryBox
GRAV	Gravimetry
MAG	Magnetometer
SWEAS	Ship Weather Station
TAP	Tap
TSG	Thermosalinograph
pCO2	pCO2 sensor

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