Cruise Report: Hans Brattström, 2026009009

2-4 March 2026, GEOF337 cruise, part 2

Cruise overview

The cruise was organized as part of the course GEOF337 at the Geophysical Institute, UiB, and we visited Masfjorden, Fensfjorden and Lurefjorden to do hydrographic work, and collect water samples. This was the second cruise of the course (following 2026009004 in 2-4 Feb 2026). This cruise report is compiled by Ilker Fer with input from Elin Darelius and GEOF337 students.

During the cruise, we performed conductivity-temperature-depth (CTD) profiling and collected water samples at each station at selected depths for calibration of salinity and oxygen measurements from the profiler. At two stations we also took samples for carbon and nutrients analysis. Station overview, details of sampling and analysis methods, and mooring details are given in the following sections.

Participants:

Cruise leader	: Ilker Fer
Teaching assistant	: Koen Joris van der Heijden
Technician	: Kristin M. Jackson
Students	: Fritjof Terland Biørn, Quanyi Zhou
	Klara Elise Pfeiffer, Benjamin Christer Aarø
Crew	: Bjørn Frode Grønnevik (captain) Carl-Magnus Nødtvedt Nilsen

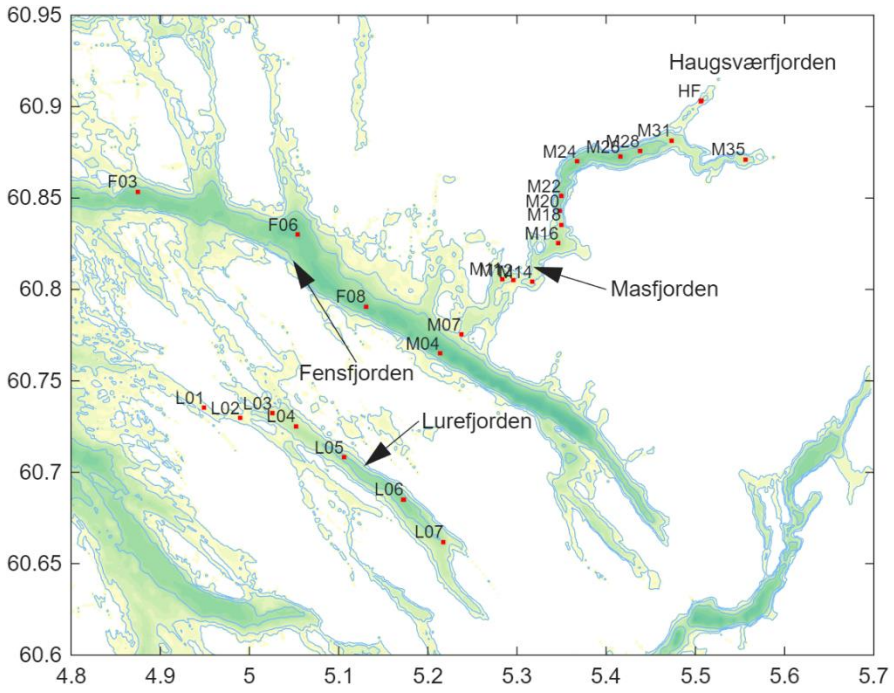

Fig. 1 Stations taken during the cruise. Isobaths highlighted are 10, 100 and 300 m.

CTD

The CTD used on board this cruise was the model RBRmaestro^3 with serial number 205914. The sensors and factory calibration dates are listed in Table 1. The CTD was attached to a water sampler from Hydro Bios, Kiel, on a frame with 6 bottles. The CTD is an internal recording instrument without telemetry, and it was not possible to see the profile collected during a station.

Table 1. Sensors on the CTD rosette

Sensor	**Units**	**Serial number**	**Calibration date**
Conductivity	mS/cm	17TI50961	2/13/2025
Temperature	°C	3971	2/11/2025
Pressure	dbar	205591	2/12/2025
Chlorophyll	µg/L	207796	4/1/2000
Temperature	°C	212754	4/1/2000
Dissolved O_2 concentration	µmol/L		4/1/2000
PAR	µmol/m^2/s		2/20/2025

We started with a test station in Byfjorden close to Bergen to test the CTD and water sampler, and to demonstrate water sampling. CTD profiling then continued in Fensfjorden, Masfjorden and Lurefjorden. At stations, we used a crane to lift the CTD sensor above the railing and into the water, profiled to a target depth of about 10 m from seafloor, and closed bottles at desired depths during the upcast. At each target depth, we waited 1 minute before closing the bottles. In total we collected 28 CTD profiles. The instrument recorded continuously, and the data files were downloaded at the end of each day. The stations are shown in Fig 1 and listed in Table 2.

Water sampling

Water samples were obtained from the Rosette available onboard during the upcast. As CTD data cannot be viewed live, sample depths were chosen beforehand. Sample depths are listed in Table 3, as recorded by the pressure sensor of the rosette. We waited at least one minute after the CTD was stopped before closing the bottle. We took water samples for salt, dissolved oxygen, DIC, and nutrients following standard procedures.

Winkler titration

Samples for measuring dissolved oxygen were collected using a tube, ensuring that each sample was as bubble-free and exposed to air as little as possible. Draw temperature was measured before we added 1 mL MnCl2 and 1 mL NaOH/NaI to the sample and put a cap on the flask. The sample was then shaken for about 20 sec, and stored dark and cool until Winkler titration started. Winkler titration was carried out onboard by Kristin M. Jackson and the students using the SIO automated Winkler titration system.

Dissolved Inorganic Carbon / Alkalinity, and nutrients

Samples for carbon analysis (dissolved inorganic carbon and alkalinity) were collected using a tube, adding four drops (ca 0.1 mL) of mercury to the sampled bottles. Samples were kept cool and dark, and brought back to GFI for analysis.

Samples for nutrients were collected by rinsing the flasks three times, then adding four drops of chloroform to the sample. Samples were stored in the fridge and sent to IMR for analysis.

Salinity

The samples were collected following standard procedures, i.e., the bottles were rinsed three times and then brought back to GFI, where they were analyzed in the lab by the students, supervised by K. Jackson-Misje.

Surface salinity samples

In addition, for training purposes, samples from the surface were collected using a separate water sampler. These samples were collected using a messenger with the sampler about 1 m below the surface. Temperature is read from the thermometer in the sampling bottle.

Processing of CTD data

The CTD-data were processed using the pyrsktools pagage and the following steps were included: computeprofiles, correcthold (interpolates when the instrument has been on hold), smooth conductivity, align channel (thermal lag correction), loopedit, bin average (1 dbar bins)

Calibration of CTD sensors

Salinity and dissolved oxygen measurements were calibrated against water sample analyses as described separately below. The following are common to both procedures:

1. Only data from the downcast are used.
2. Sensor data (salt, temperature and oxygen recorded by the RBR CTD) corresponding to the bottle closing depths are obtained from the downcast profile, interpolated to the depths of water samples recorded in the CTD-log, even though the bottles were closed during the upcast. The upcast data are of low quality and cannot be used.

Salinity

The salinity of the water samples was determined by K. Jackson together with the students using a Portasal.

The salinity calibration was conducted using data from cruise HB2026009004 and HB2026009009 jointly. Only samples collected below 105 m depth were included in the analyses, resulting in 54 samples. Three samples were flagged as outliers (>2 x std) and excluded. The mean offset (Bottle-CTD) for the 51 remaining samples was -0.0020 (in practical salinity scale).

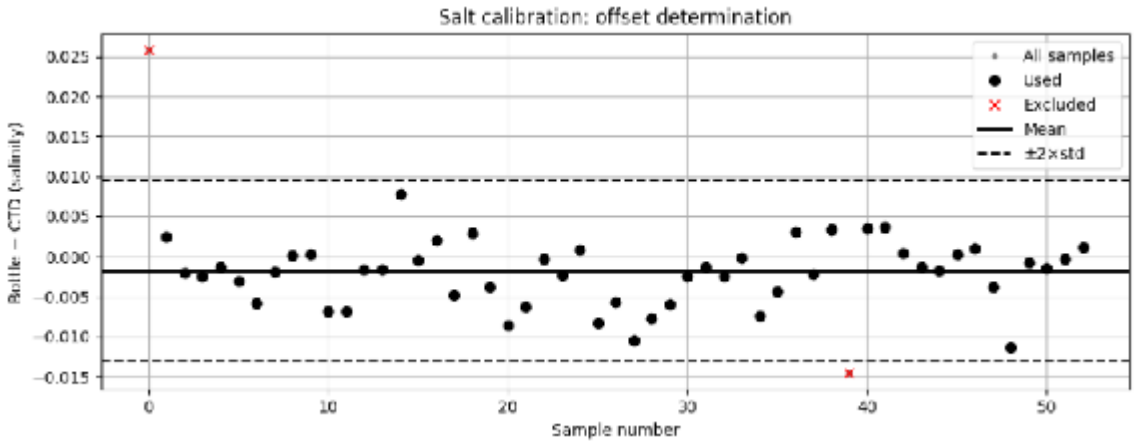

Fig.4. Vertical axis is the difference between the practical salinity from water sample analysis and measured by the CTD. Horizontal axis is the sample number.

PSAL_corrected = PSAL_measured – 0.002

Dissolved Oxygen

Oxygen concentrations recorded by the CTD's sensor and those determined through manual Winkler titration (both converted to [umol/kg]) are compared.

There were 74 samples plus 7 doubles. Nono of the samples were flagged during the analysis in the lab. Samples collected at depths shallower than 100 m and with oxygen concentrations below 50 umol/kg are excluded from the calibration.

First, outliers for which the difference between Winkler and CTD larger than the mean ±3 standard deviations were flagged. This applied to one sample that was removed from further analysis.

When the difference between doubles (samples taken from the same depth and station, but not necessarily the same Niskin) was lower than 3 umol/kg, the mean value was retained. If the value was higher than 3 umol/kg both samples were removed. Five doubles were included, and one of the doubles was removed.

A line were fitted to the remaining 56 samples, and samples with residuals larger than 2.5 x root mean square error were removed iteratively until either no more samples were removed or the root mean square error was smaller than 2 umol/kg. 54 samples were included in the final regression and the linear correction applied to the data is:

DO_calibrated=DO_observed x 1.026 - 14.6

The root mean square error is 1.97 umol/kg.

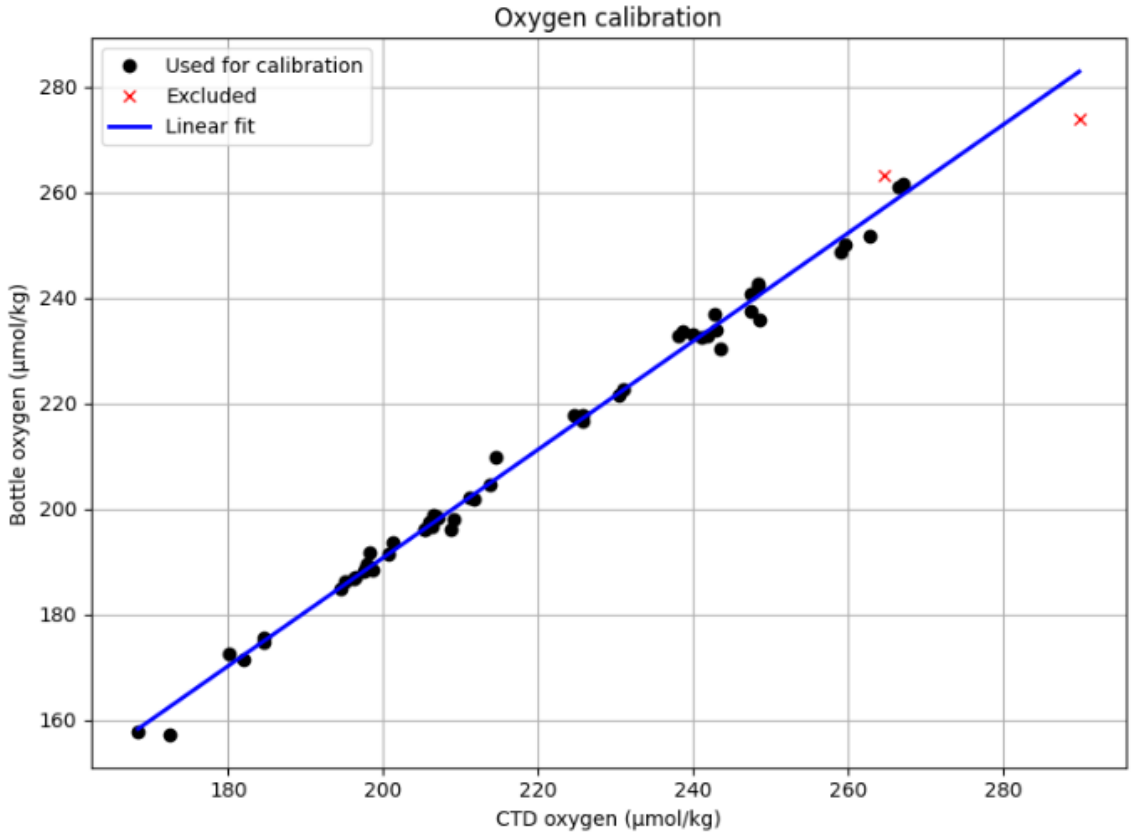

Fig.5. Dissolved oxygen concentration observed with the CTD versus that determined through Winkler titration. The blue line shows the regression line used to correct the CTD data using the data with black dots. Data points excluded during the regression analysis (see text) are marked with red crosses.

Table 2. CTD station log

CAST	St.name	Date			UTC	Depth	Latitude/ N		Longitude/ E		Water samples			Comments
		year	mon	day	hh:mm	m	deg	min	deg	min	Salt	O2	CT/nutrients	
0	test	2026	3	2	09:35	491	60	27.963	5	15.147		x		
1	F03	2026	3	2	12:05	454	60	51.207	4	52.488	x	x		
2	F06	2026	3	2	13:00	540	60	49.800	5	3.272	x	x		
3	F08	2026	3	2	13:45	568	60	47.440	5	7.845	x	x		
4	M07	2026	3	2	14:24	142	60	46.523	5	14.25	x	x		
5	M11	2026	3	2	14:45	196	60	48.346	5	17.009	x	x		
6	M12	2026	3	2	15:05	97	60	48.296	5	17.74	x	x		
7	M35	2026	3	3	08:27	181	60	52.271	5	33.346	x	x		
8	M31	2026	3	3	08:55	267	60	52.881	5	28.381	x	x		
9	HF	2026	3	3	09:20	122	60	54.192	5	30.4	x	x	x	bottles at 110, 100, 80
10	HF	2026	3	3	09:55	120	60	54.165	5	30.366	x	x	x	second cast, bottles at 50, 45, 10
11	M28	2026	3	3	10:22	423	60	52.540	5	26.253	x	x		
12	M26	2026	3	3	10:52	480	60	52.358	5	24.939	x	x		
13	M24	2026	3	3	12:15	462	60	52.196	5	22.028	x	x		
14	M22	2026	3	3	12:56	425	60	51.065	5	20.961	x	x		
15	M20	2026	3	3	13:32	368	60	50.572	5	20.864	x	x		
16	M18	2026	3	3	14:06	196	60	50.120	5	20.965	x	x		
17	M16	2026	3	3	14:39	296	60	49.519	5	20.788	x	x		
18	M14	2026	3	3	15:10	147	60	48.253	5	19.038	x	x		
19	M04	2026	3	4	07:04	651	60	45.904	5	12.804	x	x		salinity from all bottles; also surface (T=6C)
20	L07	2026	3	4	09:20	308	60	39.710	5	13.043	x	x		
21	L06	2026	3	4	09:50	420	60	41.105	5	10.366	x	x	x	salinity from all bottles; surface oxygen
22	L06	2026	3	4	10:16	420	60	41.101	5	10.37	x	x	x	
23	L05	2026	3	4	10:40	392	60	42.490	5	6.35	x	x		
24	L04	2026	3	4	11:10	248	60	43.510	5	3.12	x	x		
25	L03	2026	3	4	11:30	175	60	43.933	5	1.544	x	x		
26	L02	2026	3	4	12:13	89	60	43.779	4	59.36	x	x		
27	L01	2026	3	4	12:28	68	60	44.123	4	56.952	x	x		

Table 3. Water samples log

Cast	Station Name	Bottle 1 (pressure dbar)	Bottle 2 (pressure dbar)	Bottle 3 (pressure dbar)	Bottle 4 (pressure dbar)	Bottle 5 (pressure dbar)	Bottle 6 (pressure dbar)	SURFACE
0	test	52.0	52.0	52.0	52.0	52.0	52.0	
1	F03	455.5	405.0	405.3	304.2	203.0	103.0	
2	F06	535.0	505.3	404.4	303.2	200.5	101.7	
3	F08	562.6	562.5	562.6	303.1	303.2	303.2	
4	M07	133.2	133.2	133.2	76.7	76.7	76.7	
5	M11	188.6	188.7	188.6	101.9	101.8	101.8	
6	M12	86.8	86.8	86.7	86.8	86.8	86.8	
7	M35	172.0	172.0	172.0	100.7	100.8	100.7	
8	M31	252.5	252.5	252.5	101.5	101.5	101.4	
9	HF	112.2	112.2	101.8	101.8	81.5	81.5	
10	HF	51.5	51.5	46.4	46.4	11.3	11.3	
11	M28	414.4	414.4	414.4	202.5	202.5	202.5	
12	M26	474.9	474.9	474.9	202.8	202.8	202.7	x
13	M24	454.4	454.4	404.2	303.3	202.5	101.7	
14	M22	419.5	419.5	303.8	303.8	201.8	101.6	
15	M20	359.3	359.4	303.5	303.5	202.2	101.9	
16	M18	188.5	188.5	102.1	102.0	51.3	51.3	x
17	M16	289.6	289.6	202.7	202.7	114.3	114.3	
18	M14	141.3	141.3	102.2	102.2	51.1	51.0	
19	M04	646.9	505.3	404.9	304.3	202.9	102.2	x
20	L07	302.4	302.3	203.1	102.1	102.1	102.1	
21	L06	417.9	418.0	303.4	303.4	202.3	202.3	x
22	L06	102.0	102.0	51.2	51.2	11.0	11.1	
23	L05	385.4	385.4	202.6	202.6	101.8	101.8	
24	L04	243.0	243.0	243.0	101.7	101.7	101.7	
25	L03	167.3	167.3	167.4	102.1	102.2	102.2	
26	L02	81.2	81.2	81.2	81.2	81.2	81.2	
27	L01	58.3	58.3	58.3	58.3	58.3	58.3	

Cruise diary

UTC = LT-1 h

2 March 2026

0700 (0800 LT): meet at Nykirkekai, H Brattsöm
Loaded gear onboard; students went shopping
Setting up the water sample analyses instruments
All onboard 0815; left the kai
Instructions and information
0845 utc, fueling the vessel
0930, Test station in Byfjorden
Lunch
Stations F03, F06, F08
(skipped M04 to make sure we recover ECO on time; will take it on the way out to Lurefjorden)
M07, M11, M12
ECO did not surface (note, instrument and float about 3-5 m from seafloor; recovery float with a small flag: line in Nortek float is about 50 m)
At quai, 17:30

3 March 2026

All onboard at 0700 LT
0715 UTC Start work on recovering the ECO (dredging); not successful
Stations M35, M31
HF, Haugsværfjorden (full station); because of ice about 100 m from the original position. [Done two casts]
M28, M26, took a surface salinity sample at M26
Lunch
M24, M22, M20, M18, surface salinity at M18
M16, took DOXY at sensor levels of MF-outer (near M16; recovered on 2 feb): 112 m, 285 m
Station M14
Arrived at kai 16:40

4 March 2026

0700 LT all onboard
0615 UTC leave. No additional attempt to recover ECO; original plan was to look with ROV, but ship can't be stabilized against the currents with the anchors onboard. Crew will attempt another time.
0704 UTC, M04
0920: Starting Lurefjorden section:
L07, L06 (full station), L05, L04, L03, L02, L01
Finished L01 at 1230 UTC
Heading back to Bergen
Arrived at Nykirkekaien at 15:40 LT