

CTD Data RV Heincke HE578

Data Processing Report

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1 Introduction

This report describes the processing of CTD raw data acquired by Seabird SBE 911plus CTD on board RV Heincke during expedition HE578.

2 Workflow

The different steps of processing and validation are visualized in Figure 1. The CTD raw data are delivered from Andreas Wisotzki (AWI). The station book of the RV Heincke cruise is extracted from the DAVIS SHIP data base (<https://dship.awi.de>). The first CTD station and cast is processed manually in SBE Data Processing to configure the *.psa Seabird routines *Data Conversion, Wild Edit, Bottle Summary, Split, Translate, Cell Thermal Mass, Loop Edit* and *Bin Average*. The Seabird routines are then run in a batch job *CTDjob* in ManageCTD to process the complete CTD data set. The downcast of each CTD station/cast is used for further processing. In *CTDjob* the start record and the lowest altimeter point of the downcast is selected. From the downcast data figures to compare both oxygen sensors are generated. The oxygen sensor choice and the offset between the two oxygen sensors is documented in the processing summary table. With the *Utilities → Dship Ebook* function of ManageCTD the DAVIS SHIP station book extraction is used for getting the header information of all CTD stations/casts of the cruise. ManageCTD *Utilities → Find Profile* function compares station times of the header with the entries in the station book to find out the correct naming of the stations and casts. In *CTDheader* in ManageCTD the header information of each CTD station/cast is displayed, controlled and corrected if necessary. *CTDdespike* in ManageCTD is used for a visual check of the data and to erase/interpolate spikes in the data if necessary. Additionally, a sensor pair (Temp1/Sal1 or Temp2/Sal2) is chosen for each station/cast of the RV Heincke cruise in *CTDdespike*.

ManageCTD *Utilities → CheckDoubleSensors* controls the quality of temperature and conductivity sensors. For this purpose outliers of too high sensor pair differences could be removed. The data is then converted to spreadsheet format with *dsp2odv* for visualization of the data in Ocean Data View (ODV). The second visual inspection of the CTD data allows a comparison with data from other CTD casts from close-by stations to verify the oxygen sensor data. Therefore, potential reference cruise data is downloaded from PANGAEA (<http://www.PANGAEA.de>). The reference data is converted to *.mat format. In the ManageCTD Final Processing the CTD data is displayed together with the reference data. Bad data points, sensors or casts are interpolated or erased from the data set and filters are applied if necessary. The processed CTD data are written to text files and imported to PANGAEA (<http://www.PANGAEA.de>) for publication.

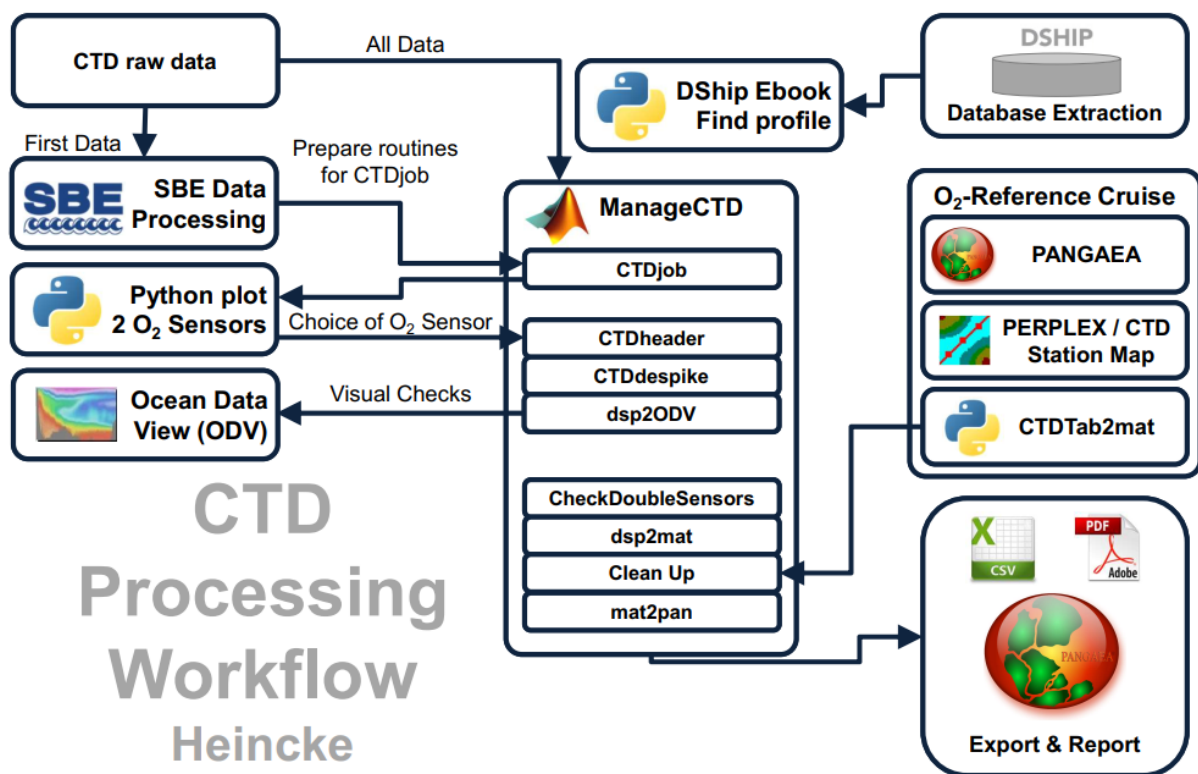


Figure 1: CTD data Processing Workflow

3 Cruise details

Vessel name RV Heincke
 Cruise name HE578
 Cruise start 05.06.2021 Bremerhaven
 Cruise end 08.07.2021 Bremerhaven
 Cruise duration 33 days
 No. of CTD casts 40

4 Sensor Layout

This chapter describes the CTD sensors mounted during this cruise:

SBE 911plus CTD (SN: 1015), SBE Instrument Configuration Version 7.23.0.1.

ID	Sensor Name	Serial No.	Calibration Date
55	TemperatureSensor	1373	11-Oct-19
3	ConductivitySensor	1198	17-Sep-19
45	PressureSensor	1015	26-Jan-17
55	TemperatureSensor	2929	13-Sep-19
3	ConductivitySensor	1199	17-Sep-19
0	AltimeterSensor	46466	23-Mar-09
71	WET_LabsCStar	1348DR	28-Jan-2016
20	FluoroWetlabECO_AFL_FL_Sensor	1365	15-Jan-2016
38	OxygenSensor	2292	26-Aug-20
38	OxygenSensor	3654	13-Feb-20

5 Processing

Details of processing procedures and processing parameters are described in *CTD Processing Logbook of RV Heincke* (hdl: [10013/epic.47427](https://hdl.handle.net/10013/epic.47427)).

Density Inversions and Manual Validation

Obvious outliers were removed manually. For the visual check density inversions $> 0.005 \text{ kg/m}^3$ and $> 0.01 \text{ kg/m}^3$ were flagged differently for display but not removed automatically. Decisions whether the flagged values were manually removed or not are based on the description in *CTD Processing Logbook of RV Heincke* (hdl: [10013/epic.47427](https://hdl.handle.net/10013/epic.47427)).

Sensor Differences

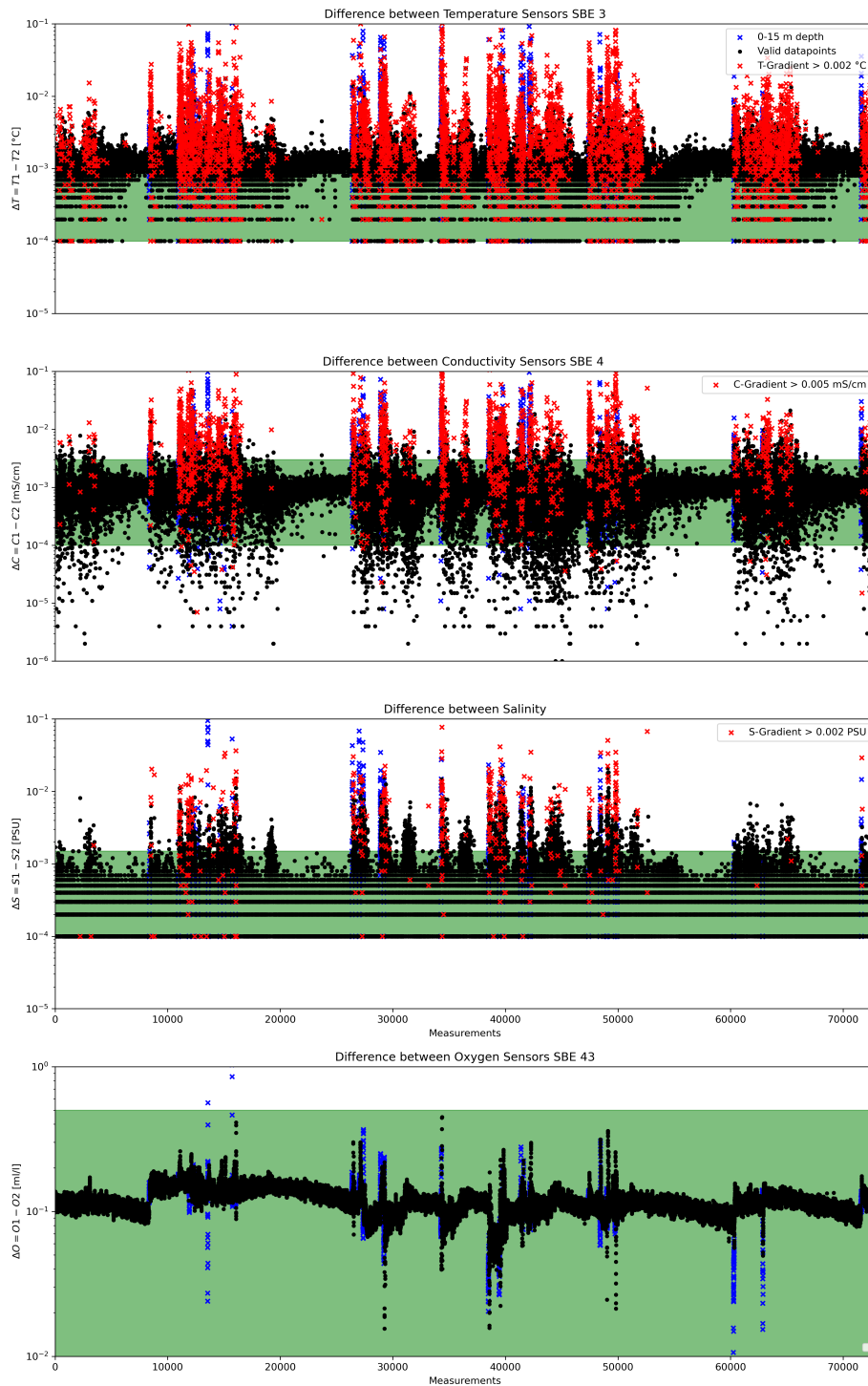


Figure 2: Data accuracy of sensor pairs HE578

6 Results

A complete processing overview for each sensor at each station is summarized in the table in the Appendix (Figure 3).

Double Sensor Check

In Figure 2, the absolute residuals between the sensorpairs are shown for the measured parameters *Temperature* and *Conductivity*, the derived parameter *Salinity* and the measured parameter *Oxygen*. Measurements in shallow water depths < 15 m (blue crosses) and gradients between two datapoints exceeding a defined threshold (red crosses) were omitted for accuracy calculation.

Parameter	Accuracy given by manufacturer	Measurements removed Surface 0-15m + gradient filter	Remaining measurements within accuracy specifications
Temperature	$\pm 0.001 \text{ } ^\circ\text{C}$	9.12%	38.63%
Conductivity	$\pm 0.003 \text{ mS/cm}$	4.94%	97.55%
Salinity	$\pm 0.0015 \text{ PSU}$	3.23%	96.35%
Oxygen	$\pm 2.0 \text{ \% of saturation}$	2.59%	100.00%

Comments

- 38 CTD "max depth/on ground" entries in DShip station book
- 34 CTD raw data sets delivered
- 3 CTD casts had a wrong filename
- 34 CTD casts processed and uploaded
- of these 34 processed CTD casts:
 - 0 oxygen profiles deleted (spiky and not matching to reference casts)
 - 3107 data points interpolated
 - 12 data points erased
- Water depth of some stations out of measurement range.

Result files

Text File (HE578_phys_oce.tab):

The format is a plain text (tab-delimited values) file.

Column separator	Tabulator "\t"
Column 1	Event label
Column 2	Date/Time of event
Column 3	Latitude of event
Column 4	Longitude of event
Column 5	Elevation of event
Column 6	DEPTH, water
Column 7	Pressure, water
Column 8	Temperature, water
Column 9	Conductivity
Column 10	Salinity
Column 11	Temperature, water, potential
Column 12	Density, sigma-theta (0)
Column 13	Oxygen
Column 14	Oxygen, saturation
Column 15	Attenuation, optical beam transmission
Column 16	Fluorometer
Column 17	Number of observations

Processing Report (CTD-HE578-report.pdf):

This PDF document.

Station	Gear	Date	Time	Position	Position	Depth	File Name	Sensor	Temp		Sal		Trans		Fluor		Oxy		Complete		2 Oxy Sensors		Oxygen reference		Comments				
									interp	erased	interp	erased	interp	erased	interp	erased	interp	erased	interp	erased	interp	erased	interp	erased		interp	erased	interp	erased
1-1	CTD	07.06.2021	06:14	60° 45.221'N	004° 00.720' E	323.1	HE578	pair	11		11		11		11		2292	-0.10	HE358/047-3	165.52	0.4								
1-5	CTD	07.06.2021	10:00	60° 44.976'N	004° 00.594' E	317.8		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		
2-2	CTD	08.06.2021	06:09	60° 44.938'N	003° 24.968' E	330.5		2	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	wrong file name	
2-5	CTD	08.06.2021	09:51	60° 45.026'N	003° 25.024' E	330.5		2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3		
3-2	CTD	09.06.2021	06:38	60° 45.084'N	001° 59.887' W	118.7		2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3		
3-6	CTD	09.06.2021	09:57	60° 45.039'N	001° 59.862' W	119.2		2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3		
4-1	CTD	10.06.2021	06:22	61° 15.048'N	002° 59.977' W	0.0		2	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57		
4-5	CTD	10.06.2021	10:17	61° 15.089'N	002° 59.759' W	0.0		2	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12		
5-1	CTD	11.06.2021	06:02	60° 44.982'N	000° 07.098' E	119.0		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		
5-5	CTD	11.06.2021	09:56	60° 45.005'N	000° 07.094' E	120.3		2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
6-2	CTD	12.06.2021	05:59	60° 45.028'N	001° 10.008' E	153.0		2	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	
6-6	CTD	12.06.2021	09:51	60° 45.043'N	001° 10.030' E	145.5		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	water depth >2000m
8-1	CTD	17.06.2021	06:34	74° 31.877'N	008° 59.959' E	N/A		2	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84		
8-5	CTD	17.06.2021	11:32	74° 31.854'N	008° 59.999' E	N/A		2	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	water depth >500m	
9-7	CTD	18.06.2021	10:04	74° 31.200'N	012° 30.175' E	N/A		2	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	water depth >1700m	
9-11	CTD	18.06.2021	15:05	74° 31.285'N	012° 29.850' E	N/A		2	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	water depth >500m	
10-1	CTD	19.06.2021	06:29	74° 30.602'N	015° 00.363' E	N/A		2	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	water depth >1700m	
10-5	CTD	19.06.2021	11:13	74° 30.496'N	015° 00.267' E	N/A		2	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	water depth >500m	
11-1	CTD	20.06.2021	05:05	74° 30.003'N	016° 40.065' E	196.8		2	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9		
11-5	CTD	20.06.2021	06:03	74° 29.997'N	016° 40.001' E	197.1		2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
13-5	CTD	21.06.2021	09:50	71° 45.095'N	019° 44.265' E	16.9		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		
14-1	CTD	22.06.2021	06:06	70° 59.973'N	019° 54.140' E	184.7		2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
14-5	CTD	22.06.2021	09:55	71° 00.046'N	019° 54.102' E	186.4		2	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7		
15-2	CTD	23.06.2021	06:04	71° 19.989'N	019° 40.975' E	208.7		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		
15-6	CTD	23.06.2021	09:47	71° 20.024'N	019° 40.647' E	213.6		2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3		
16-1	CTD	24.06.2021	06:02	70° 40.020'N	019° 57.924' E	194.2		2	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16		
16-5	CTD	24.06.2021	09:50	70° 40.066'N	019° 56.257' E	199.1		2	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	
18-2	CTD	26.06.2021	06:29	69° 28.991'N	010° 57.208' E	0.0		2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5		
19-1	CTD	29.06.2021	07:18	68° 34.809'N	013° 35.299' E	129.5		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
19-5	CTD	29.06.2021	10:19	68° 34.730'N	013° 34.606' E	133.3		2	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	
22-1	CTD	02.07.2021	06:20	63° 11.506'N	003° 23.710' E	N/A		2	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	
22-5	CTD	02.07.2021	10:24	63° 11.517'N	003° 23.630' E	N/A		2	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	water depth >800m
23-1	CTD	03.07.2021	06:05	62° 29.050'N	004° 56.689' E	196.3		2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5		
23-5	CTD	03.07.2021	09:49	62° 29.040'N	004° 56.685' E	195.0		2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
									620	4	627	4	620	0	620	0	620	4	620	0	620	4	620	0	620	4	620	4	
									3107	12	3107	12	3107	12	3107	12	3107	12	3107	12	3107	12	3107	12	3107	12	3107	12	

Figure 3: CTD data Processing Summary HE578
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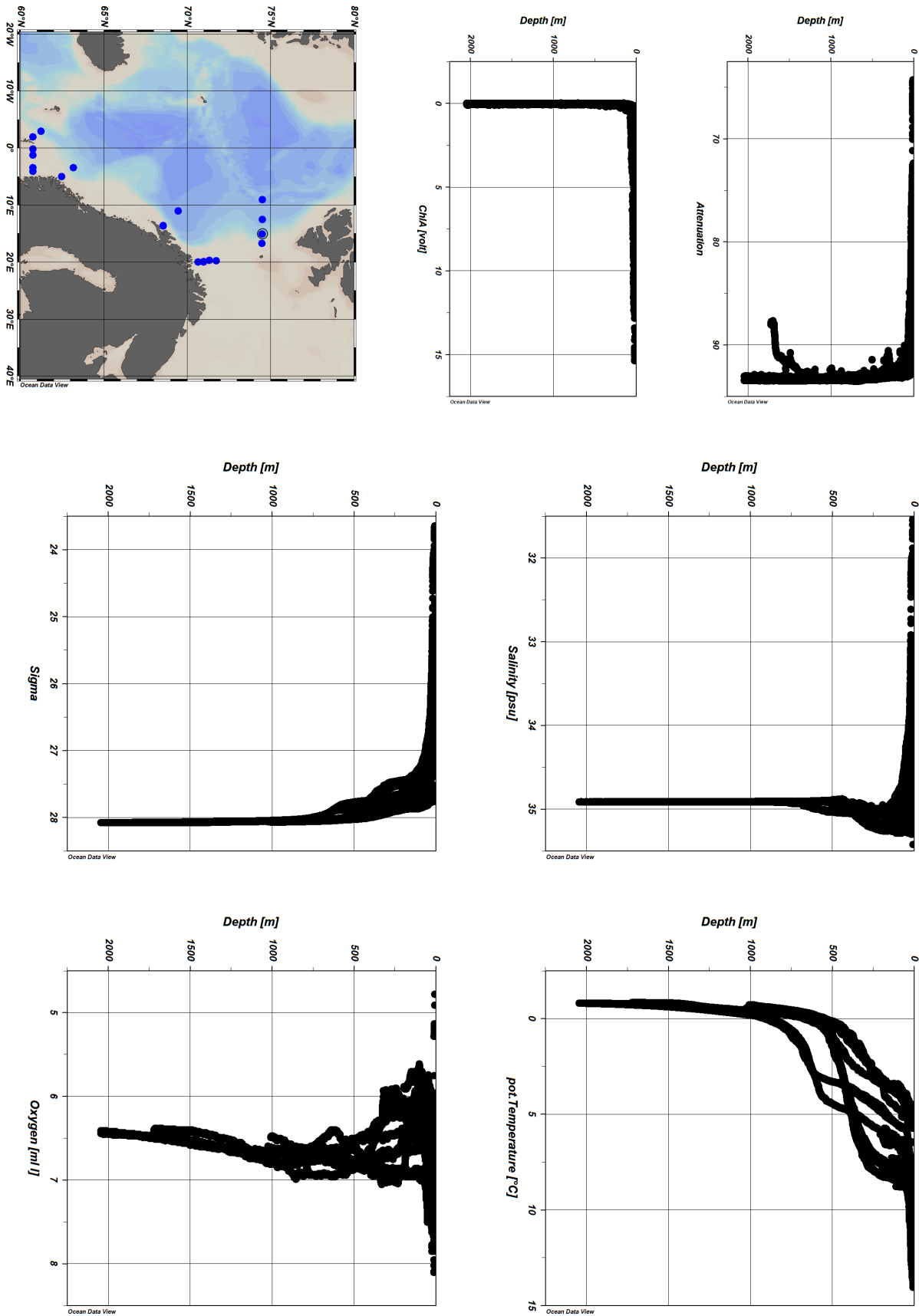


Figure 4: ODV Screenshot of HE578 CTD data