Physical, Chemical and Biological Oceanographic Data collected in Chatham Sound and Hecate Strait, 2018 -2020

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Canadian Data Report of Hydrography and Ocean Sciences 228

Canadian Data Report of Hydrography and Ocean Sciences

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ABSTRACT

Wright, C.A., Johannessen, S.J., Hannah, C., and Covert, P. 2025. Physical, chemical and biological oceanographic data collected in Chatham Sound and Hecate Strait, 2018-2020. Can. Data Rep. Hydro. Ocean. Sci. 228: ix + 128p.

Oceanographic data, water and sediment samples were collected in the Chatham Sound region, including the Skeena River estuary, from 2018 to 2020. Oceanographic sampling included seasonal station profiles with CTD/Rosettes (Conductivity, Temperature, Depth sensor) and water samples.In addition, moorings were deployed,with CTDs dissolved oxygen sensors and current meters. Station-specific electronic data profiles included temperature, salinity, dissolved oxygen and fluorescence. Water samples were analyzed for nutrients, salinity, dissolved oxygen, chromophoric dissolved organic matter, total/dissolved organic carbon (TOC/DOC), oxygen stable isotopes ($d^{18}O$), and suspended particulate matter concentration (SPC). SPC samples were also analyzed for total organic carbon, nitrogen and stable isotopes of carbon and nitrogen ($^{13}\delta C$ and $^{15}\delta N$). Water samples were also collected along a salinity gradient in the Skeena River estuary to assess the extent and influence of the river on Chatham Sound and its reaches. Seasonal transects by small boat collected CTD data, as well as water samples for nutrients and other tracers, such as CDOM, $^{18}\delta O$, TOC and DOC.

Three moorings were deployed in Chatham Sound, one in central Chatham Sound (CHAT-1) and two in tidal passages connected to the Sound (CHAT-2, CHAT-3). Moorings were deployed for approximately 1 year at a time. The CHAT-1 mooring included sediment traps for the collection of particulate fluxes. However, these traps failed to perform: the mooring was hit by a fishing boat in the first year, and the traps were overwhelmed with sediment in the second.

In 2018, sediment cores were collected with a Pouliot Box corer. The cores were sub-sectioned, dated using ^{210}Pb and ^{226}Ra, and then analyzed for organic carbon, total nitrogen, biogenic silica, and the stable isotopes $^{13}\delta C$ and $^{15}\delta N$.

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RÉSUMÉ

Wright, C.A., Johannessen, S.J., Hannah, C., et Covert, P. 2025. Données océanographiques physiques, chimiques et biologiques recueillies dans le détroit de Chatham et le détroit d'Hécate, 2018-2020. Rapport Can. de données. Hydro. Océan. Sci. 228: ix + 128p.

De 2018 à 2020, des données océanographiques, des échantillons d'eau et de sédiments ont été prélevés dans la région du détroit de Chatham, y compris dans l'estuaire de la rivière Skeena. Les

données océanographiques comprenaient des stations où des des profils saisonniers ont été effectués avec une rosette pour échantillonner l'eau. La rosette était munie d'un CTD (capteur de conductivité, de température, de profondeur) qui permet de mesurer la température et la salinité, en plus de l'oxygène et de la fluorescence de l'eau avec des capteurs électroniques. Les échantillons d'eau prélevés par la rosette ont été analysés afin de déterminer les sels nutritifs, la salinité, l'oxygène dissous, la matière organique dissoute chromophorique (MODC), le carbone organique total/dissous (COT/COD), les isotopes stables d'oxygène (d18O) et la concentration en matières particulaires en suspension (SPC). Ces matières particulaires en suspension ont également été analysées pour le carbone organique total, l'azote et les isotopes stables du carbone et de l'azote (13δC et 15δN). Des échantillons d'eau supplémentaires ont pareillement été prélevés le long du gradient salin de l'estuaire de la rivière Skeena afin d'évaluer l'étendue et l'influence de la rivière sur le détroit de Chatham et ses tronçons. Ces transects saisonniers, effectués en utilisant des petites embarcations, ont recueilli des données CTD, ainsi que des échantillons d'eau pour mesurer les concentrations de sels nutritifs et d'autres traceurs, tels que le MODC, le 18δO, le COT et le COD.

Travaux de terrain, trois mouillages ont également été déployés dans le détroit de Chatham, l'un dans le centre du détroit (CHAT-1) et les deux autres dans des passages d'eau plus profonds reliés au détroit (CHAT-2, CHAT-3). Chaque mouillage a été déployé pour une période d'environ un an avant d'être récupéré et redéployé. Les mouillages étaient munis de courantomètres, ainsi que des CTDs installés à diverses profondeurs. Plusieurs des CTDs avaient la capacité de mesurer la concentration d'oxygène dissous. De plus, le mouillage CHAT-1 comprenait des pièges à sédiments afin de mesurer le flux de particules. Cependant, aucun des pièges n'a fonctionné, car le mouillage a été heurté par un bateau de pêche lors de la première année de déploiement , alors que les pièges ont été submergés de sédiments lors de la seconde année de déploiement .

En 2018, des carottes de sédiments ont été prélevées à l'aide d'un carottier Pouliot Box dans la région. Les carottes ont été sous-sectionnées, datées à l'aide de 210Pb et de 226Ra, puis analysées pour le carbone organique, l'azote total, la silice biogène et les isotopes stables 13δC et 15δN.

Ces travaux ont été financés par le Plan de protection des océans du gouvernement du Canada.

1.0 Introduction

This document reports physical, biological and geochemical data collected by Fisheries and Oceans Canada from July 2018 to August 2020, in and around Chatham Sound, BC. The study area encompasses the waters of Chatham Sound, Dixon Entrance, eastern Hecate Strait, Portland Inlet and Pearse Inlet (Figure 1).

Data were collected under the Oceans Protection Plan – Baseline, in order to develop a regional nitrogen budget and to assess baseline water and sediment properties. Sampling cruises primarily took place in July/August (2018-025, 2019-069, 2020-069), with additional cruises in October (2020-083), November (2019-103) and February (2019-001, 2020-001). The Skeena River was sampled by small boat in August 2019 (2019-069), November 2019 (2019-103), February 2020 (2020-001) and October 2020 (2020-083). In addition to the water sampling, moorings were deployed at three locations in Chatham Sound.

Depth profiles of temperature, salinity, transmissivity, fluorescence, and dissolved oxygen were collected using a CTD-rosette system. Water samples were analyzed for dissolved oxygen, salinity, nutrients, dissolved organic carbon, total organic carbon, coloured dissolved organic matter and oxygen stable isotopes. Water samples were also collected and filtered to determine the concentration and chemical composition of suspended particles. Sediment box cores were radiometric dated using ^{210}Pb and ^{226}Ra, and analyzed for organic carbon, total nitrogen, biogenic silica and stable isotopes of carbon and nitrogen. Surface water samples were collected from the Skeena River to determine freshwater composition endmembers.

The data are tabulated and/or plotted in this report and are available electronically on request from the IOS data archive (waterproperties.ca.)

2.0 Methods

2.1 Study Area and Sampling Logistics

Figure 1 shows the sampling areas, CTD-rosette stations and locations for cores and moorings. All stations were used for vertical CTD profiling. Water samples were collected at most of the CTD stations, but the exact set of water sampling stations varied among cruises. Oceanographic surveys took place in July/August (2018-025, 2019-069 and 2020-069), October/November (2020-083), and February (2019-001 and 2020-001). A separate, river-only expedition (2019-103) took place in November. Not all stations were visited during every cruise, nor was the full set of parameters measured at every station. See the report section for each cruise for details.

2.2 Mooring Configurations

CHAT1 and CHAT2 were deployed in July 2018. CHAT 3 was added in August 2019. The moorings included single-point current meters, CTDs with oxygen sensors, ADCPs and ambient noise recorders (data not shown) (Figure 2). Sampling intervals varied among the instruments to balance sampling rate against battery life. Moorings were deployed for approximately 1 year at a time, from one summer cruise to the next.

Baker-style sediment traps (Baker and Milburn,1983, and O'Brien *et al*, 2000) were deployed on CHAT1. Unfortunately, in December 2019, CHAT1 was hit and dragged 1.4 km north. The damage to the mooring, and specifically to the sediment traps, resulted in a total loss of trap samples. For the second deployment (beginning in August 2019), only a single 10-cup trap was deployed at approximately 100m, with each cup collecting for 30 days. Unfortunately, the high sediment deposition at this location overwhelmed the poison in the trap, rendering the samples unusable due to the high degree of degradation. After this, there were no further deployments of sediment traps in this project, and there are no data to report.

CTD data from moorings were compared with deployment and retrieval casts from the shipboard SBE911, using both data with time stamp coincidence and longer-interval T-S tests (24-36 hours). Problematic data were corrected if possible, or else excluded. See report section for individual deployments for details.

ADCP data were processed at the Institute of Oceans Sciences (Hourston *et al*. 2021). Netcdf files were opened in Ocean Data View (v.5.6.4) and lightly gridded using next-to-neighbour methods employed within Ocean Data View.

Aquadopp current meter data were corrected for magnetic declination, and final magnitude speed and direction were plotted. No other corrections were made to these data.

The CHAT1-1 mooring was hit and dragged northward during its first deployment (CHAT1-1). Both instrument packages continued to function at the new location. However, they were positioned 10 m deeper than at their original site, and the upper instrument package, including the ADCP, was in a reverse orientation from its original position. Only the CTD data are reported here. The 10 mab instruments were also pulled 10 m deeper than their original position, and only the CTD data are reported.

Mooring configurations and sensor depths changed between deployment years. Figure 2 shows the configuration for the first deployment of each mooring; some sensors were subsequently added and/or removed.

2.3 CTD Profiling

During the oceanographic surveys, a SeaBird SBE911 CTD was deployed to measure vertical profiles of temperature, conductivity (salinity) and pressure, with additional sensors for dissolved oxygen (SBE43), chlorophyll fluorescence (Wetlabs and Seapoint), and transmissivity (Wetlabs C-Star). Data were collected at maximum frequency (24 Hz) on both downcast and upcast. The CTD was allowed to equilibrate and purge bubbles at the surface and then was lowered to near-bottom waters at a rate of 1m s^{-1}. In order not to disturb the surface waters (which are highly stratified in this region except in winter), all equilibrations took place near the surface (0.5 - 2 m). Only the downcast data are plotted in this report.

CTD data were post-processed at the Institute of Ocean Sciences (IOS) using standard routines to correct for thermal mass, hysteresis, and descent rate. Data were de-spiked and filtered, and bad data removed or flagged. Data were corrected using calibrations, knowledge of sensor history and also against long-term climatology for errors that had likely resulted from sensor drift. Electronic dissolved oxygen data were checked occasionally against Winkler titrations and corrected as appropriate. Finally, data were binned to 1-m averages. All CTD data (raw, partially processed and final product) are archived at IOS and freely available through the Water Properties open data portal (www.waterproperties.ca).

2.4 Water Property Sampling

Water samples were collected using a 24-bottle rosette system. The 10-L Niskin bottles were fired at standard depths (in meters: 0, 5, 10, 25, 50, 75, 100, 150, 200, 250, 300, 400, 500, bottom-5) on the upcast. Bottles were allowed to equilibrate at each depth for a minimum of 30 seconds prior to firing. Samples were collected for nutrients (nitrate + nitrite, silicate, soluble orthophosphate and (during 2018-25 only) ammonium), throughout the water column. At the surface, 50 m and bottom, samples were collected for coloured dissolved organic matter (CDOM), dissolved organic carbon (DOC), total organic carbon (TOC), and oxygen stable isotopes ($\delta^{18}O$). If the station depth was < 75 m, the 50 m sample was moved to 30 m. Extracted chlorophyll (surface, 10 m and 20 m only) and extracted phaeopigments were also collected. A salinity sample was collected from every bottle (data not shown) for conductivity cell calibration on the SBE9 and for comparison with certain bottle-derived analyses (e.g. $\delta^{18}O$). At a few stations samples were collected for analysis of dissolved oxygen by Winker titration to validate the electronic DO sensor data.

Additionally, full Niskins were collected at the surface for suspended particle concentrations (SPC). Each Niskin was completely emptied into a carboy that was shaken gently to distribute particles, and then subsamples of this water were collected into containers of known volume. Water was filtered under low vacuum onto a pre-combusted (at 450°C for 5 hours), pre-weighed, 25 mm GF/F filter (Whatman brand, nominal pore size 0.7 μm). If filter clogging prevented the full subsample from being filtered, the actual filtered volume was recorded. Filters were then frozen at -20 °C. On return to IOS, the filters were dried at 50 °C in a drying oven to a constant weight and weighed on a Toledo Mettler balance to ±0.0001 g. The particle weight was divided by the volume filtered to determine the suspended particle concentration (SPC) in mg L^{-1}. Carbon and nitrogen concentrations and stable isotopic composition ($\delta^{13}C$, $\delta^{15}N$) were determined on the triplicate filters (see Section 2.4).

Initially, only surface waters were sampled for suspended particles, but starting in 2020-069, near-bottom waters were also collected.

2.5 Chemical Analysis of Water Samples

Oxygen samples were analyzed at sea using an automated Winkler titration system (Metrohm Dosimat model 876 with a UV light source and detector with a 365 nm filter, controlled by LVO2_876 software designed and constructed by Scripps Institution of Oceanography), with modifications based on Carpenter (1965) and adhering to WOCE protocols (Culberson 1991).

Nutrient samples were collected in plastic tubes and quick-frozen in aluminum blocks stored at -20 °C. All samples were returned to IOS for analysis. They were analyzed using an Astoria analyzer following methods described by Barwell-Clarke and Whitney (1996).

Ammonium samples were collected and analyzed following a method modified from Holmes *et al.* (1999). The present ammonium analysis at IOS is a simplified fluorometric technique. Changes to the Holmes methodology include a lower sample volume (40 ml), a lower reagent volume (10 ml), the use of glass containers, and a longer incubation period (9-10 hours). Standards were prepared, using low-organic seawater to reduce the need for additional collections and the spiking of samples.

Chlorophyll samples were filtered onto 25 mm GF/F filters (nominal pore size 0.7 μm) and stored in glass scintillation vials at -20 °C prior to analysis. Samples were extracted in 90% acetone at -20 °C for 24 hours in the lab and analyzed on a Turner 10AU fluorometer calibrated with commercially-available pure chlorophyll *a* (Sigma). Fluorescence readings taken before and after acidification were used to calculate the concentration of chlorophyll (Holm-Hansen *et al.* 1965). The average of two replicate samples is reported.

For phaeopigment analysis, samples were extracted in 95 % methanol at -20 °C for 24 hours and analyzed on a Waters 2695 HPLC, paired with a 2996 Photodiode Array detector, using the method of Zapata *et al.* (2000). Pigment concentrations were determined from peak areas calibrated using commercial pigment standards. The complete analytical technique is described by Nemcek & Peña (2014).

Salinity samples were collected in 200 mL Type ll glass bottles with disposable plastic inserts and screw caps, supplied by Ocean Scientific International Limited. They were analyzed in a temperature-controlled lab on a Guildline 8400B salinometer, standardized with IAPSO standard seawater.

Dissolved organic carbon (DOC) and total organic carbon (TOC) samples were collected in pre-cleaned scintillation vials (40 ml) with 0.125 cm Teflon low-bleed septa. The vials were cleaned in Extran 300 and rinsed several times with Type I Ultrapure water. Vials were then soaked in 10% HCl for a minimum of four hours and rinsed several times with Type I Ultrapure water. They were allowed to dry and then baked at 450 °C for a minimum of 5 hours. Septa were briefly washed in 10% HCl, rinsed with Type I Ultrapure water and allowed to air dry. TOC was collected directly from the spigot of the Niskin bottle, while the DOC samples were filtered through a Millipore Opticap XL Durapore 0.22 µm inline filter cartridge (Product No. KVGLA04HH3) attached to the spigot. Samples were frozen at -20 °C. TOC and DOC will be analyzed on a Shimadzu TOC-L, following SOP 7 of Dickson *et al*. (2007) with some expected modifications due to the use of different acids and sparging times. Not all DOC or TOC samples have been analyzed at the time of this report.

Coloured dissolved organic matter (CDOM) samples were collected using the same filter as for the DOC samples and refrigerated in 125 ml amber bottles for analysis on return to IOS. Spectral absorbance (280-700 nm at 1nm resolution) was measured with a HP Agilent 8453 spectrophotometer. Data were corrected for instrument offset, and the linearized spectral absorption slope coefficient was determined using a curvilinear best fit curve over 280-550nm (See Johannessen *et al*., 2007 and Stedmon *et al.*, 2000). The instrument offset accounts for temperature, scattering and refractive index differences between the sample and the blank (Type I water).

Oxygen isotope samples were collected directly from the Niskin spigot into 30 ml plastic (PETG or PP) bottles, the cap secured with parafilm, and refrigerated. The samples were analyzed at the G. G. Hatch Stable Isotope Laboratory at the University of Ottawa, using an Isotope Ratio Mass Spectrometer (IRMS) Delta Plus XP (Thermo, Germany) interfaced with a GasBench II. 0.6 mL was pipetted into an Exetainer. Samples and internal standards were flushed with a gas mixture of 2 % CO_2 in helium off-line. Exetainers were left to equilibrate at either 25 °C or simply room temperature for >5 days.

Oxygen isotope data are reported in delta notation, δ. The units are per mil (‰) and defined as $\delta = ((Rx-Rstd))/Rstd)*1000$, where R is the ratio of the abundance of the heavy to the light isotope. $\delta^{18}O$ is normalized to internal standards calibrated to international standards VSMOW (0,0), GISP(-24,8, -189,5) and SLAP (-55,5, -428.0) and reported in ‰.

Precision of the oxygen isotope data is evaluated by including in every sequence a reference water standard, known as W-20. The measured values of this water are used for long term monitoring and statistical purposes. W-20 is reported as the average of the measured values, n, and the standard deviation of the sequence. Generally, a sequence run holds 65 samples, and includes 4 sets of internal standards (known as W-7,9,10) and 4 blind standards (W-20). the standard deviation of W-20 is less than 0.15 ‰. Random duplicates of a sample are also run.

Suspended particles were analyzed for carbon, nitrogen and stable isotopes ($\delta^{13}C$, $\delta^{15}N$) at the University of British Columbia . For organic carbon, filters were first acid-fumed to remove inorganic carbon. Total nitrogen and organic carbon were measured in a CHN analyser, following Calvert and Pedersen (1995). Stable isotopes of carbon and nitrogen were measured using VG PRISM IRMS, with a Carlo-Erba CHN analyser. Data are presented vs. air for $\delta^{15}N$ and vs. Pee Dee Belemnite for $\delta^{13}C$.

2.6 River Sampling

There were two phases to Skeena River sampling; surface collections for S. Johannessen during ship-based expeditions and quarterly sampling by P. Covert. Surface water samples were collected from the Skeena River in October/November (2019-103, 2020-083), July/August (2019-069) and February (2020-001). Sampling locations were determined by salinity, not position, so the geographic positions of the stations varied. The farthest upstream sample was collected at S=0, or as close as could be reached given the river flow conditions in each season. Additional samples were collected at intervals, downstream from the freshwater end-member, along a fresh-marine mixing gradient. Temperature and salinity were measured using a YSI Pro-Plus conductivity probe that was calibrated on the day of sampling. The probe was placed within the top 10cm of the water until readings stabilized. Surface water samples were collected by hand- dipping containers into the surface water. Containers were rinsed three time and then samples collected in the upstream current. Samples were collected for $\delta^{18}O$, TOC, and nutrients (N, Si, P). Salinity samples were collected to confirm salinity probe readings. Larger samples (1 – 2 L) were also collected for later filtration and analysis of suspended particles, CDOM and DOC at some stations.

Samples collected during quarterly environmental surveys were in cooperation with the Prince Rupert Port Authority. In-situ measurements and water sampling protocols were designed to capture full water column salinity and temperature profiles and to collect water samples near the surface and bottom. If the depth was greater than 100 m, a water sample was collected at 100 m depth. Vertical water profiles were collected with a hand-deployed RBR Concerto3 conductivity, temperature, depth (CTD) instrument. The CTD was lowered at a rate of approximately 1 ms^{-1}. Sampling frequency was 8 Hz. Raw CTD sensor data were processed following the recommendations of Halverson et al. (2017). Water samples were collected at the bottom of each cast using a 5 L Niskin bottle centered 2 m above the position of the conductivity and temperature sensors on the CTD. From each Niskin bottle, nutrient, salinity, $\delta^{18}O$, and dissolved inorganic carbon / total alkalinity (DIC/TA) samples were collected.

In situ bottle temperatures were estimated from the vertical temperature profiles (2m above the bottom of the cast). Nutrient and salinity samples were analyzed at the Institute of Ocean Sciences (see above).

DIC/TA, $\delta^{18}O$, and full water column CTD data from the quarterly surveys will be made available in a forthcoming publication.

2.7 Sediment Core Sampling and Dating

Five cores were collected in the study area, during cruise 2018-069, using a Pouliot box corer (Cores Port 1, CHAT1, CHAT2, CH8, and CH28). Sediment cores were sectioned in the shipboard laboratory within a few hours of collection into 1-cm intervals for the uppermost 10 cm, 2-cm intervals for the next 10 cm and 5-cm intervals for the remainder of the core. Core descriptions are provided in Table 4. Sediment consisted primarily of silty mud with some sand. Core sections were homogenized and then subsampled for analysis of ^{210}Pb and ^{226}Ra, carbon, nitrogen, biogenic silica, $\delta^{15}N$ and $\delta^{13}C$.

Subsamples for each core depth were sent to Flett Research Ltd. in Winnipeg, Canada for analysis of ^{210}Pb and ^{226}Ra. ^{210}Pb activity was measured in all sections of the core following the procedure of Eakins and Morrison (1978), while that of ^{226}Ra was determined at three depths (top, middle, bottom) in each core, from the in-growth of ^{222}Rn over at least 4 days, as per Mathieau *et al.* (1988) with modifications by Flett Research Ltd. Data from the radiochronology completed to date are presented in this report (Table 1).

Core samples for C, N, Si, $\delta^{15}N$ and $\delta^{13}C$ were analyzed at the University of British Columbia, as described above.

3.0 Results

Data are presented cruise by cruise. For the purposes of this report, the study area has been divided into three regions (Figure 1). Water column data are presented by region within each cruise. Data were plotted using Ocean Data View v. 3.4.3 (Schlitzer, R., 2009) and mooring ADCP data using version 5.6.4 (Schlitzer, R, 2023).

For each cruise there is a map showing the sampling stations and the locations of moorings and sediment cores, where applicable, followed by plots of the associated data. For the three years, the mooring data are shown in the section for the associated deployment cruise.

Water column data from 2018-025 are shown in Figures 3-28; 2019-001 in Figures 29-39; 2019-069 in Figures 40-50; and 2020-001 in Figures 57-73. Sediment core data are presented with the data from 2018-025 (Table 1, Figures 9, 10), which is when the cores were collected.

Skeena River data for all seasons are shown at the end (Figures 74-78 and Table 2).

4.0 References

Baker, E.T. and Milburn, H.B. 1983. An instrument for the investigation of particle flux. Cont. Shelf Res. 1:425-435.

Barwell-Clarke, J. and Whitney, F. 1996. Institute of Ocean Sciences Nutrient Methods and Analysis. Can. Tech. Rep. Fish. Aquat. Sci. 182: 43pp.

Carpenter, J.H. 1965. The Chesapeake Bay Institute Technique for the Winkler Dissolved Oxygen Method. Limmnol. & Oceanogr. 10: 141-143.

Culberson, C.H. 1991. Dissolved Oxygen. WOCE Hydrographic Programme Operations and Methods (July 1991). 15pp.

Dickson, A.G., Sabine, C.L., and Christian, J.R. (eds). 1997. Chapter 4. Recommended standard operating procedures: SOP 2, 3B, and 7. *In*: Guide to the Best Practices for Ocean CO_2 Measurements. PICES Special Publication 3: IOCCP Report 8.

Eakins, J.D. and Morrison, R.T. 1978. A new procedure for the determination of lead-210 in lake and marine sediments. Int. J. of Appl. Radiat. Is. 29:531-536.

Halverson, M, Jackson, J., Richards, C, Melling, H, Hunt, Brusting, R, Dempsey, M, Gatien, G, Hamilton, A, Jacob, W, and Zimmerman, S. 2017. Guidelines for Processing RBR CTD Profiles. Can. Tech. Rep. Hydro. Ocean Sci., 314: iv+38p.

Holm-Hansen, O. Lorenzen, C.J., Holme, R.W., and Strickland, J.D.H. 1965. Fluorometric determination of chlorophyll. J. Cons. Perm. Int. Explor. Mer. 30:3-15.

Holmes, R.M., Aminot, A., Kerouel, R., Hooker, B.A., and Peterson, B.J. (1999) A simple and precise method for measuring ammonium in marine and freshwater ecosystems. Can. J. Fish. Aquat. Sci., 56 1801-1808.

Hourston, H. G., Wan, D., and Guan, L. 2021. New tools for ADCP data processing. Can. Tech. Rep. Hydrog. Ocean Sci. 336Vi+36p.

Johannessen, S.C., Peña, M.A., and Quenneville, M.L. 2007. Photochemical production of carbon dioxide during a coastal phytoplankton bloom. Est. Coast. Shelf Sci. 73:236-242.

Mackas, D.L. 1992. Seasonal cycle of zooplankton off southwestern British Columbia. Can. J. Fish. Aquat. Sci. 49:903-921.

Mathieau, G.G., Biscaye, P.E., Lupton, R.A. and Hammond, D.E. 1988. System for measurement of ^{222}Rn at low levels in natural waters. Health Physics, 55: 989-992.

Munk, W.H. 1981. Internal waves and small-scale processes. In: Evolution of Physical Oceanography. B.A. Warren and C. Wunsch, Editors. pp. 264-291. MIT Press.

O'Brien, M.C., Soon, M., Nielsen, B., Elliot, C., Juhasz, T., Macdonald, R.W., Denman, K.L., Thomson, R.E. and Calvert, S.E. 2000. Sediment trap data from the Strait of Georgia, May, 1995 to January, 1999. Can. Data. Rep. Hydrog. Ocean Sci. 155: 92pp.

Nemcek, N., and Peña, M.A. 2014. Institute of Ocean Sciences Protocols for Phytoplankton Pigment Analysis by HPLC. Can. Tech. Rep. Fish. Aquat. Scie. 3117: x+80p.

Schlitzer, R. , 2009 (v.3.4.3), .2023 (v. 5.6.4). Ocean Data View, http://odv/awi.de

Stedmon, C.A., Markager, S., Kaas, H. 2000. Optical properties and signatures of chromophoric dissolved organic matter (CDOM) in Danish coastal waters. Est. Coast. Shelf Sci. 51:567-578.

Throndsen, J. 1978. Preservation and Storage. *In* Phytoplankton Manual. Edited by A. Sournia. UNESCO Monographs on Oceanographic Methodology. Paris, France. pp. 69-74.

Vagle, S., McDonald, A. and Klinke, J. 2013. Annual CTD Profiling On Transit to Canadian Arctic; Underway CTD Profiles on Moving Vessels. Sea Technology Magazine, June 2013.

Veronis, G. 1972. On the properties of seawater defined by temperature, salinity and pressure. J. Mar. Res. 30:227-225,

Wright, C.A., Johannessen, S.J., Macdonald, R.W., Burd, B.J., Hill, P. Van Roodselaar, A., Bertold, S. 2007. The Strait of Georgia ambient monitoring program: phase I, 2002-2007: sediment and benthos. Can. Data Rep. Fish. Aquat. Sci. 1208: 112 p.

Zapata, M., Rodriguez, F., Garrido, J.L. 2000. Separation of chlorophylls and carotenoids from marine phytoplankton: a new HPLC method using a reversed-phase C8 column and pyridine-containing mobile phases. Mar. Ecol. Prog. Ser. 195, 29-45.

5.0 Acknowledgements

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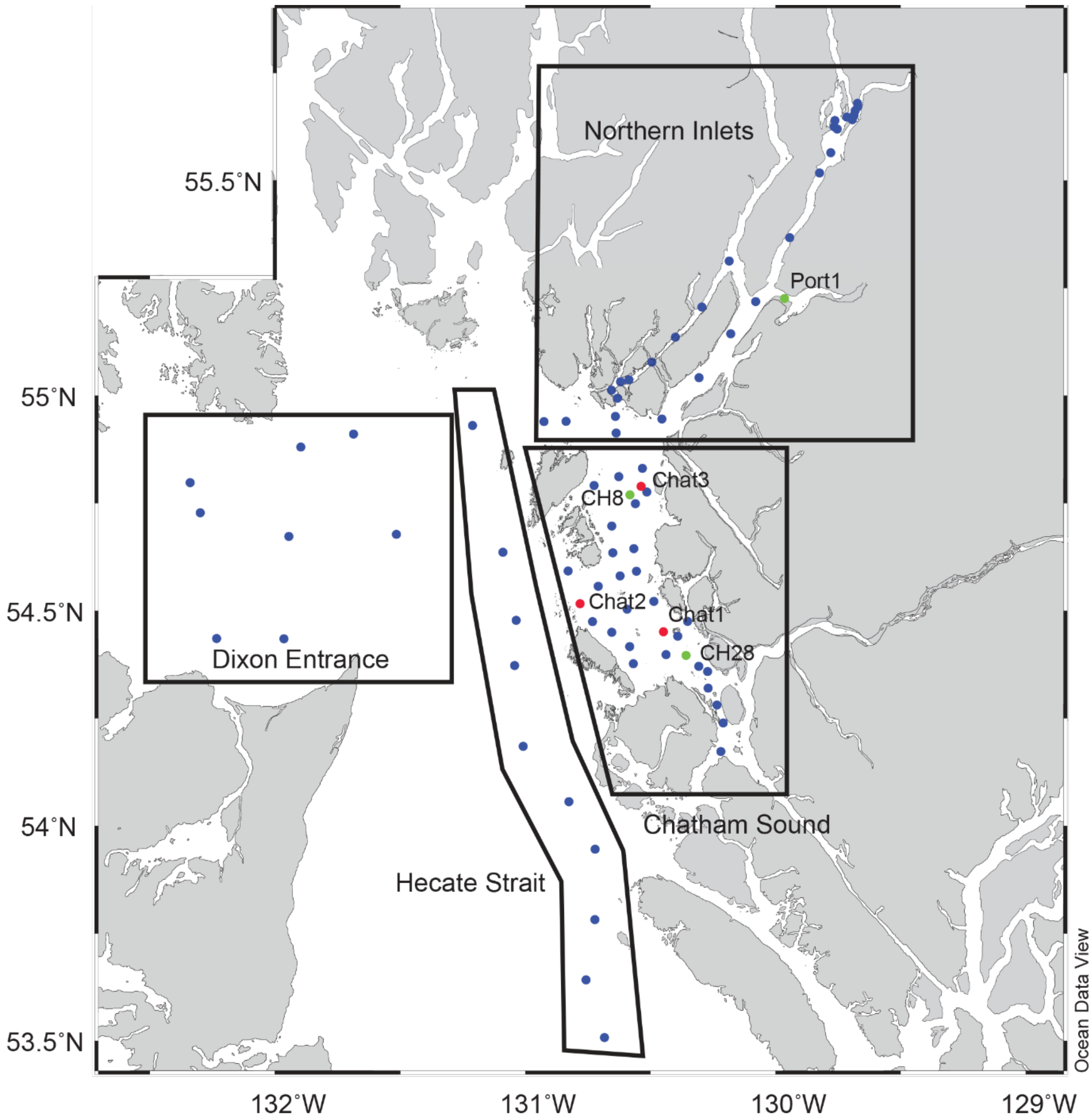

Figure 1. Overview of sample locations. Red dots represent mooring locations and green dots represent sediment cores. Sediment cores were also taken at Chat1 and Chat2. All stations, including blue dots show the location of CTD/rosette casts.

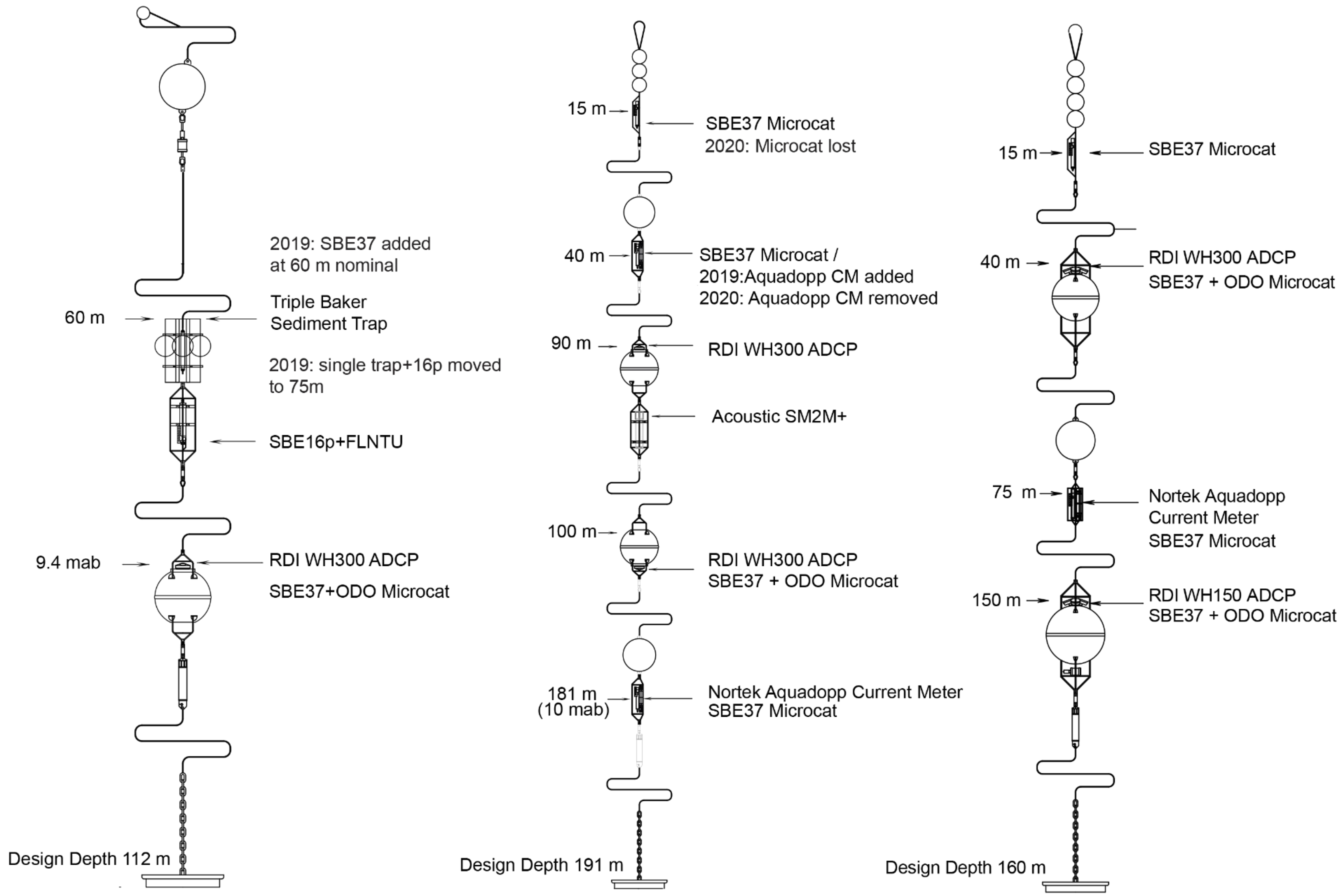

Figure 2. Chat1, 2 and 3 mooring design and instrument configuration. Chat1 and 2 were first deployed in 2018, Chat3 was first deployed 2019. Chat1 was not deployed in 2020.

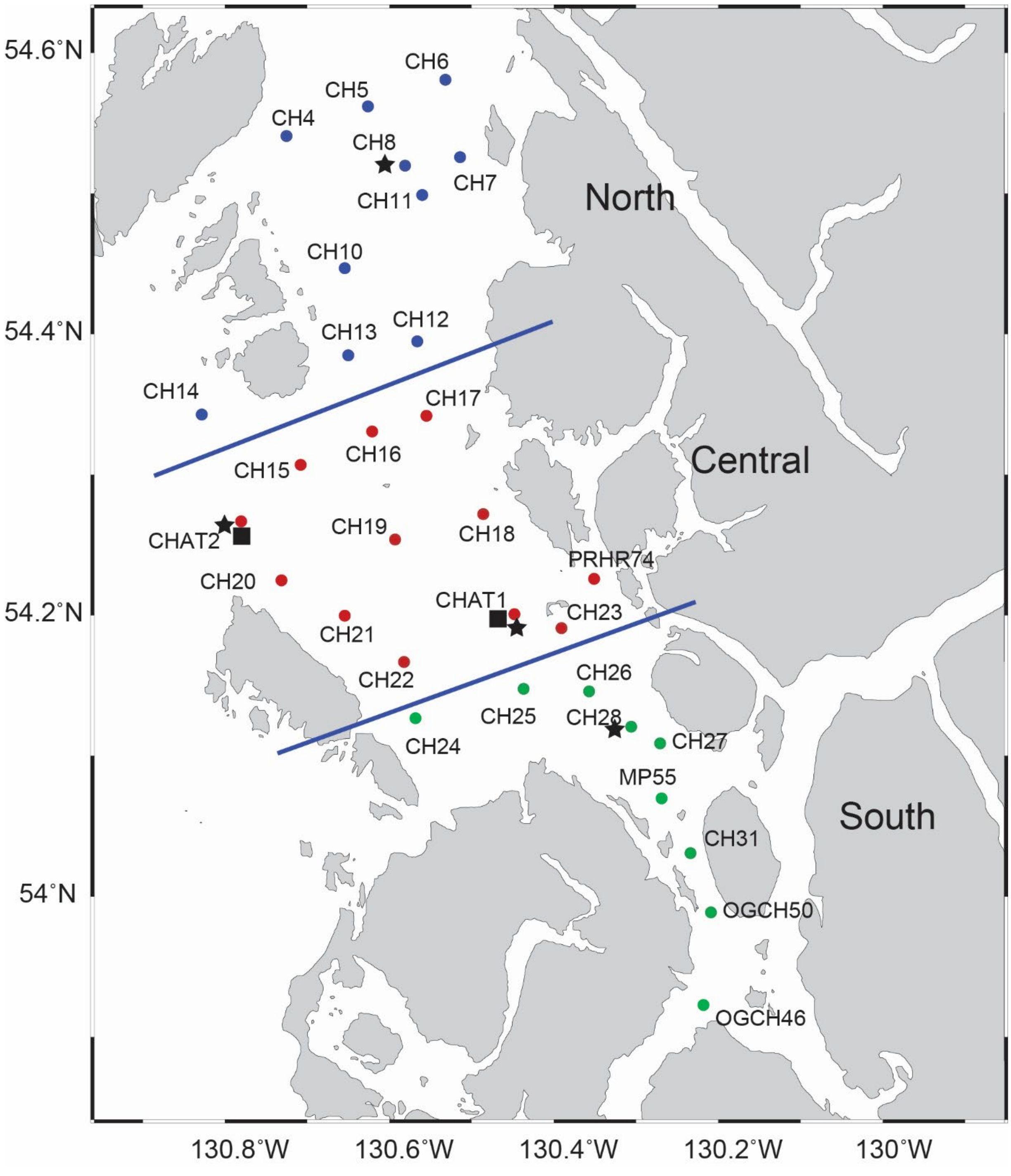

Figure 3. Chatham Sound Region Station Map 2018-025. Squares represent mooring locations and stars represent core locations.

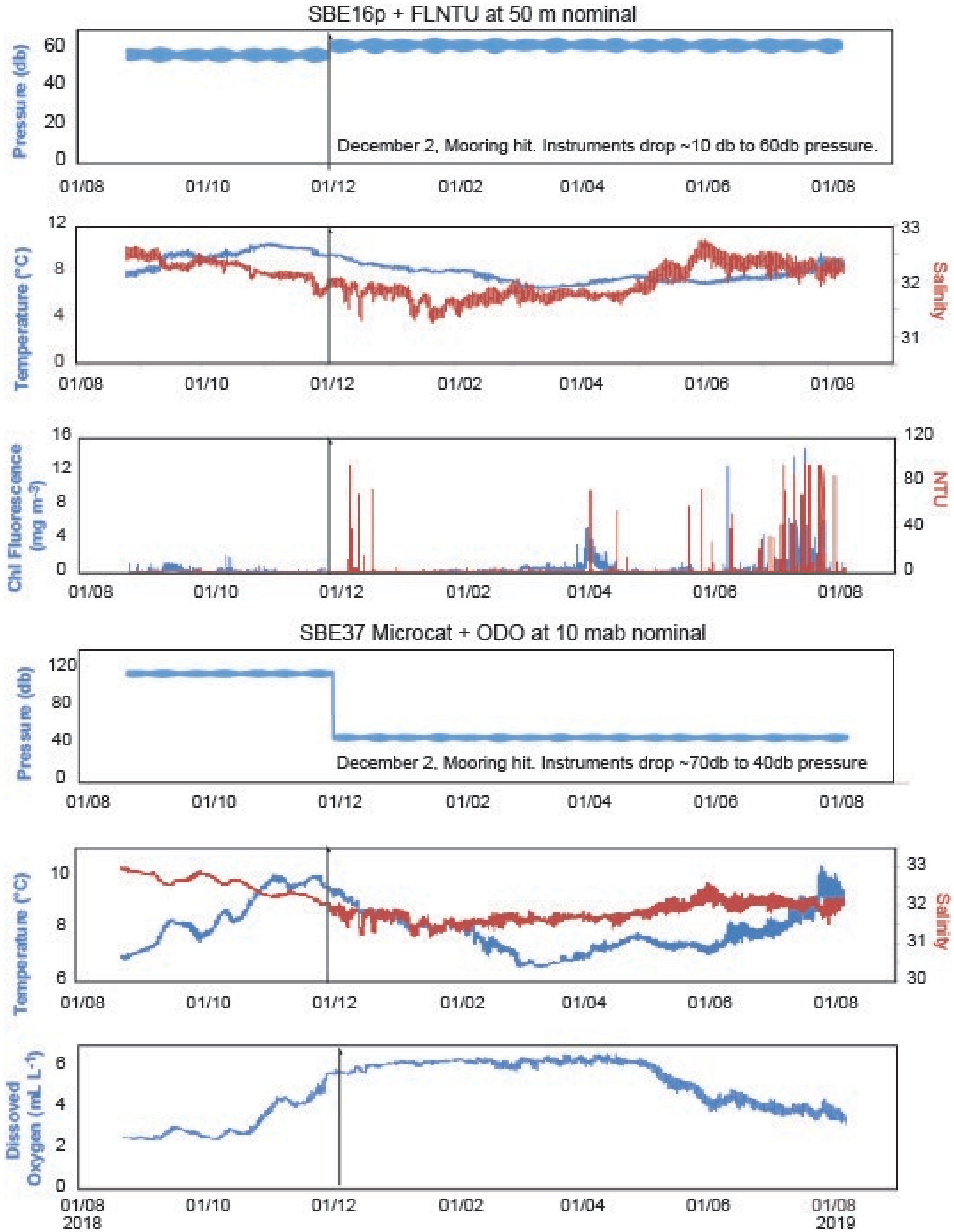

Figure 4. Time series for instrumentation collected on CHAT1-1, 2018-2019. Vertical line marks December 2, 2018, when the mooring was hit and moved.

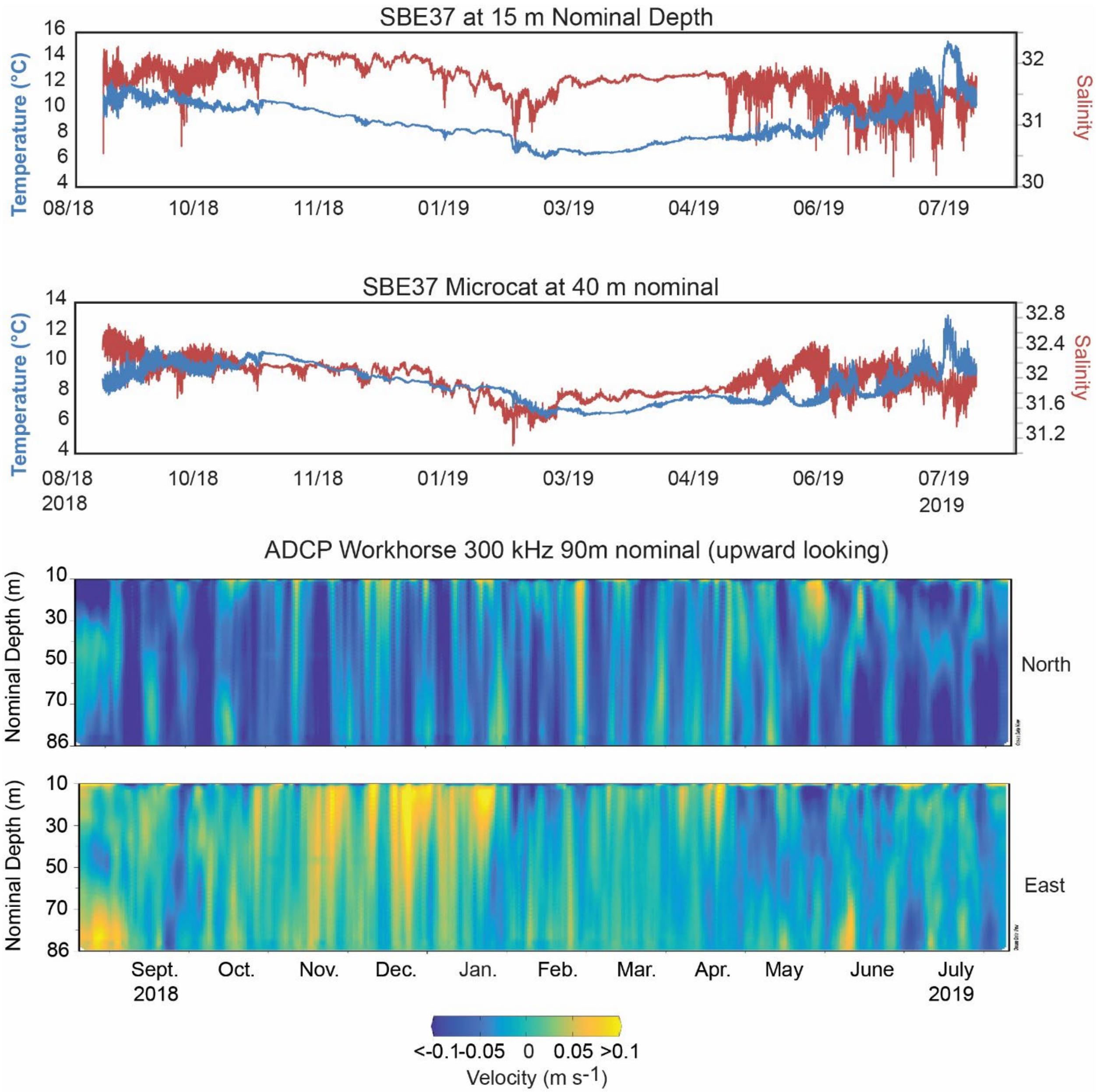

Figure 5. Time series for instrumentation collected at CHAT2-1, 2018-2019.

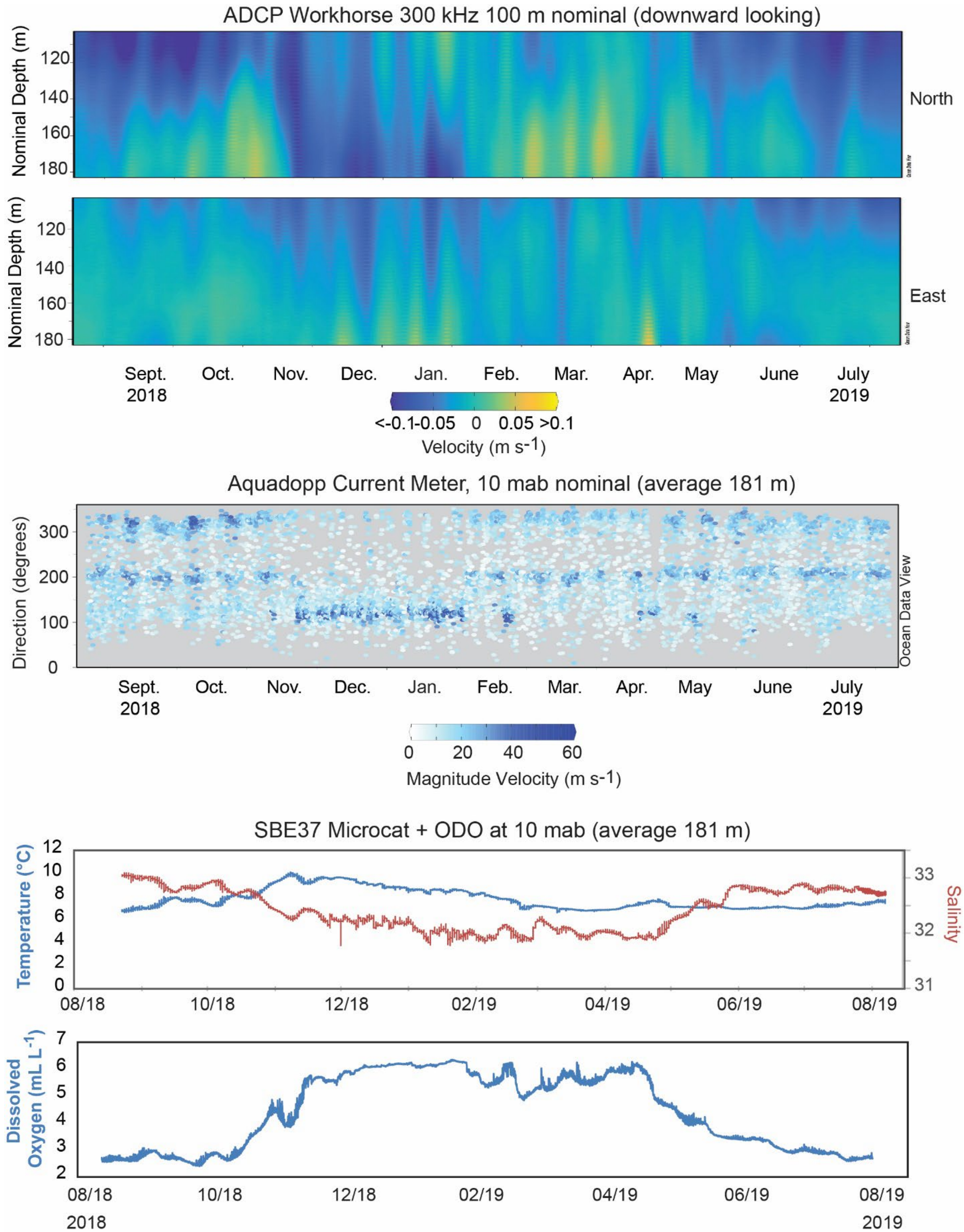

Figure 5 continued. Time series for instrumentation collected at CHAT2-1, 2018-2019.

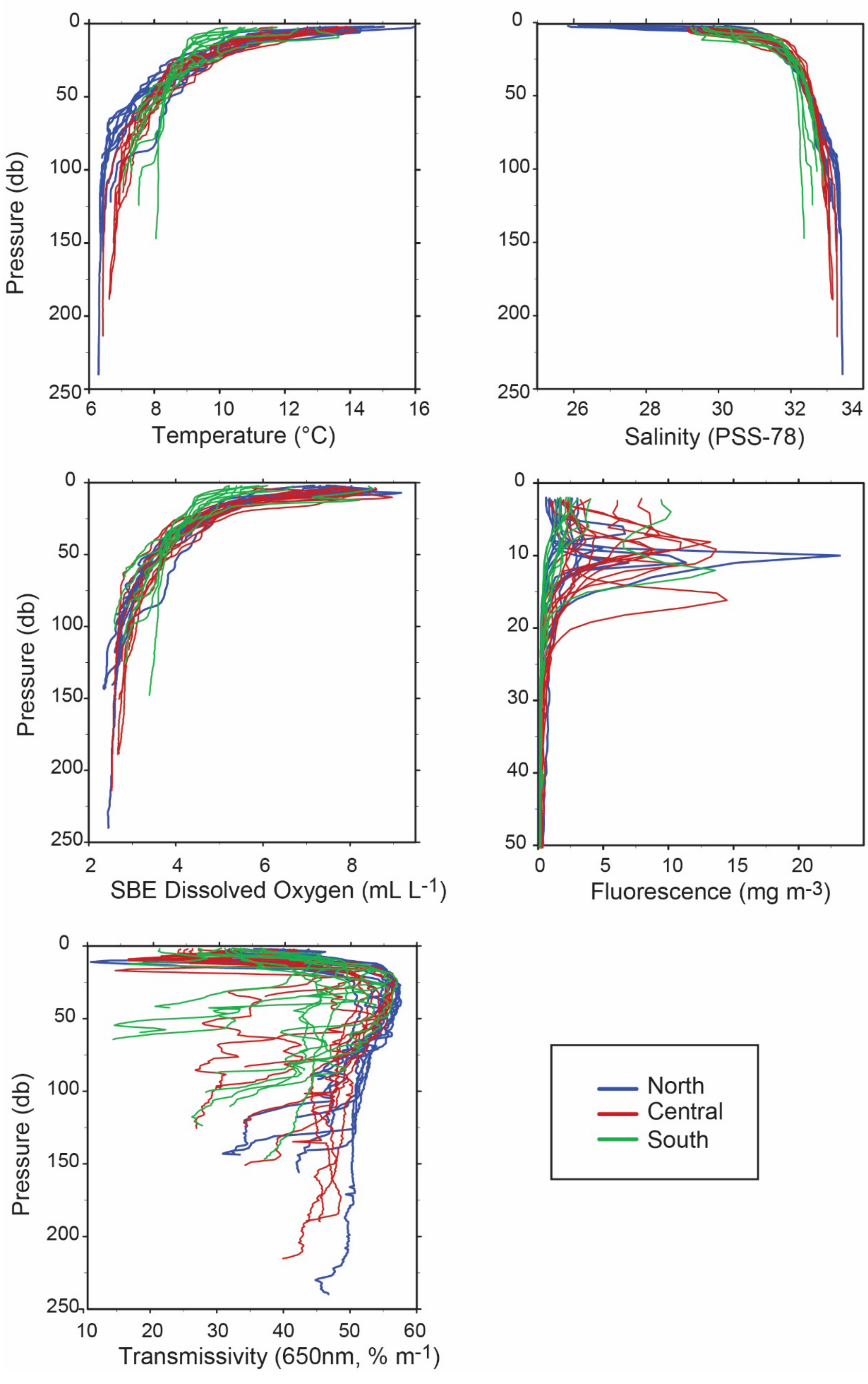

Figure 6. SBE911 data collected during 2018-025, Chatham Sound Region.

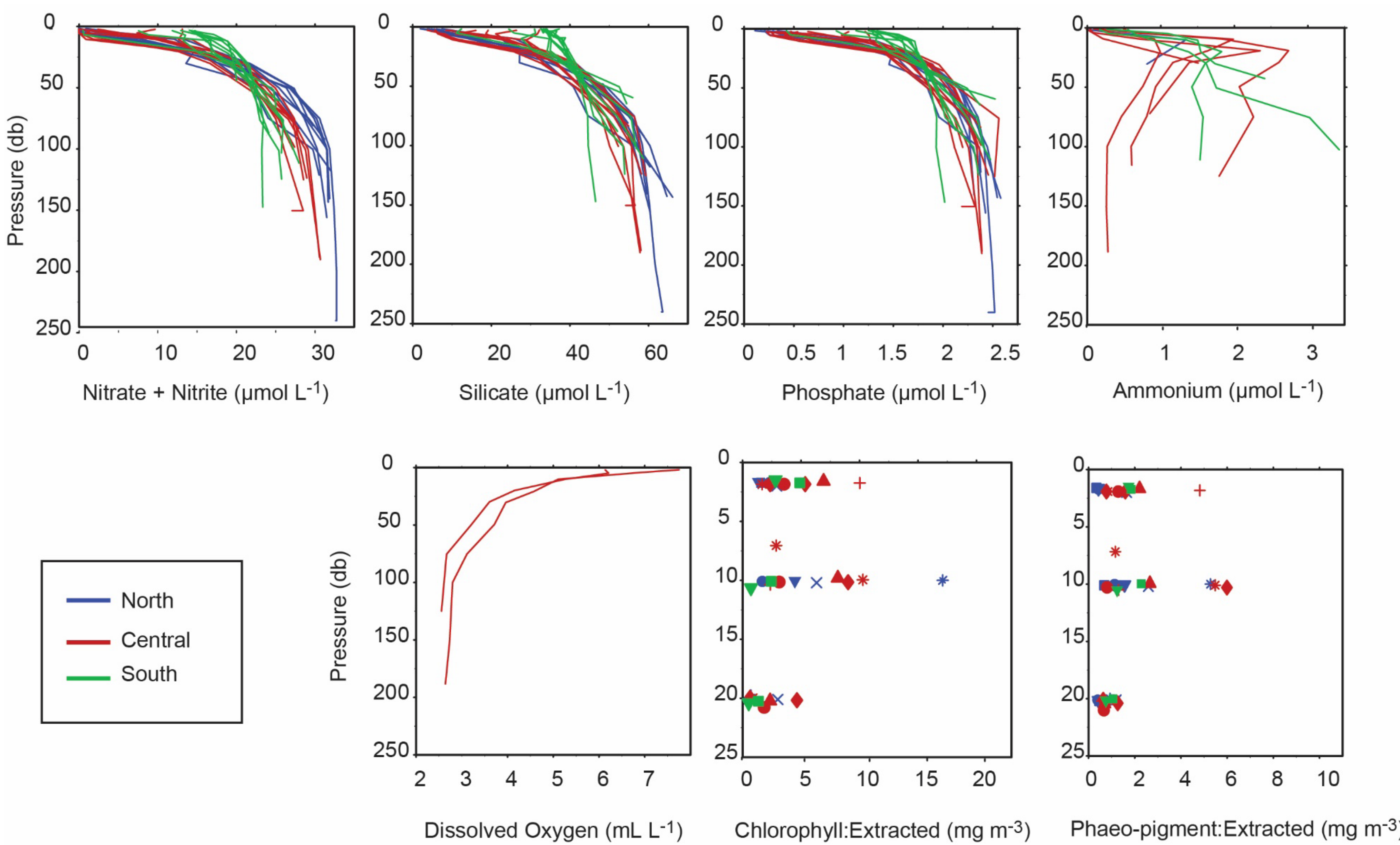

Figure 7. Niskin bottle data collected during 2018-025, Chatham Sound Region.

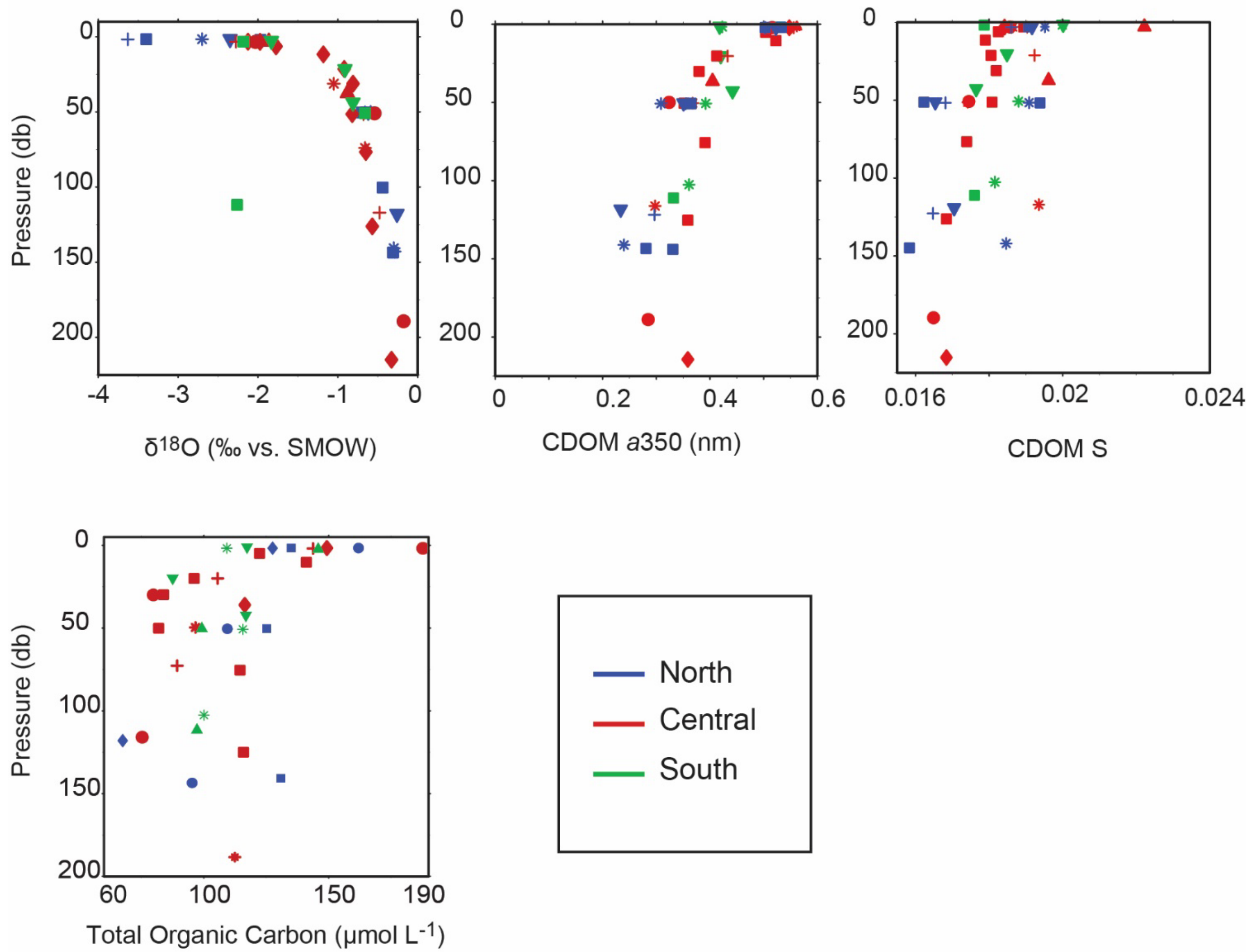

Figure 7 continued. Niskin bottle data collected during 2018-025, Chatham Sound Region.

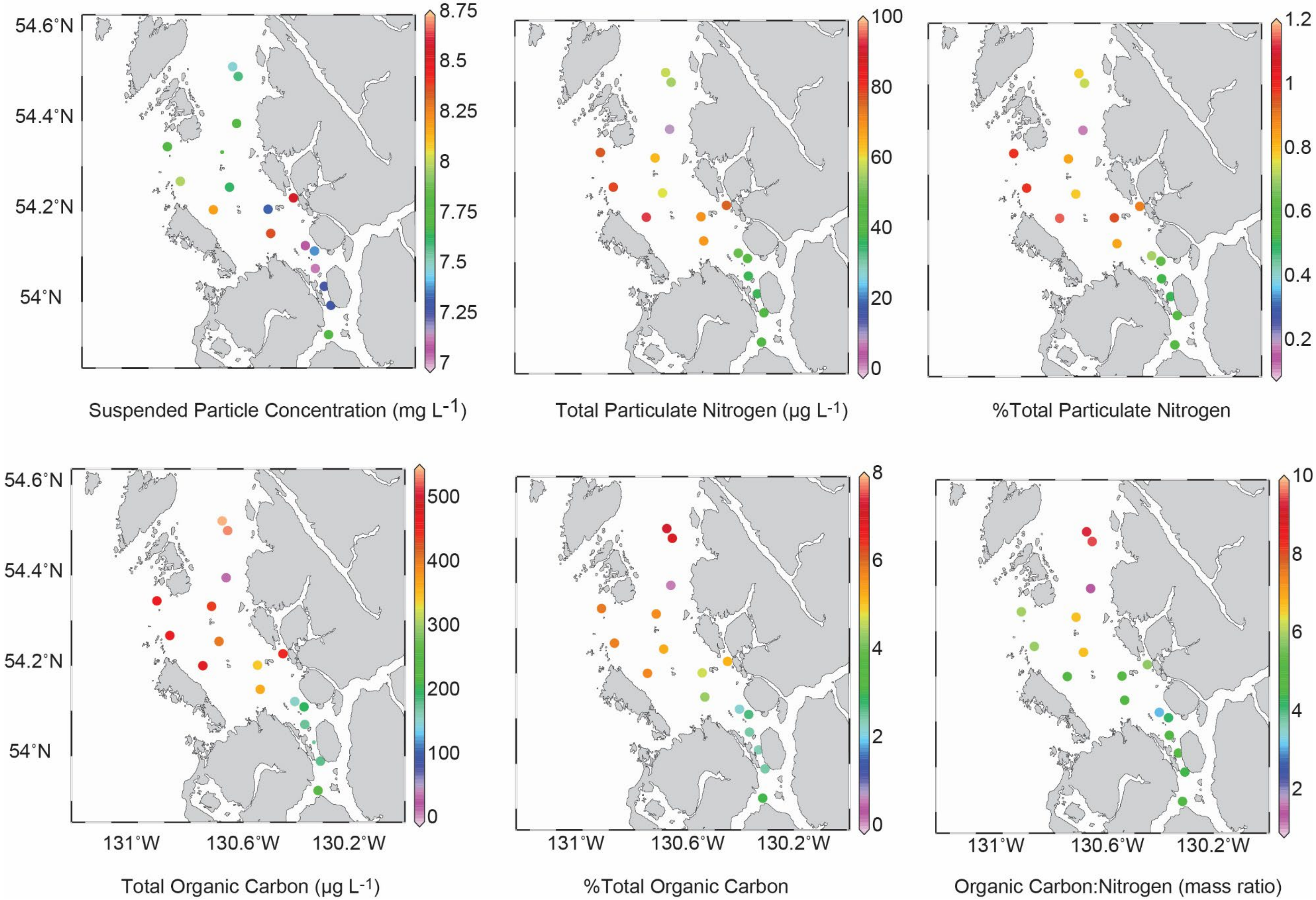

Figure 8. Results of the GFF suspended particulate matter analysis collected on 2018-025, Chatham Sound Region.

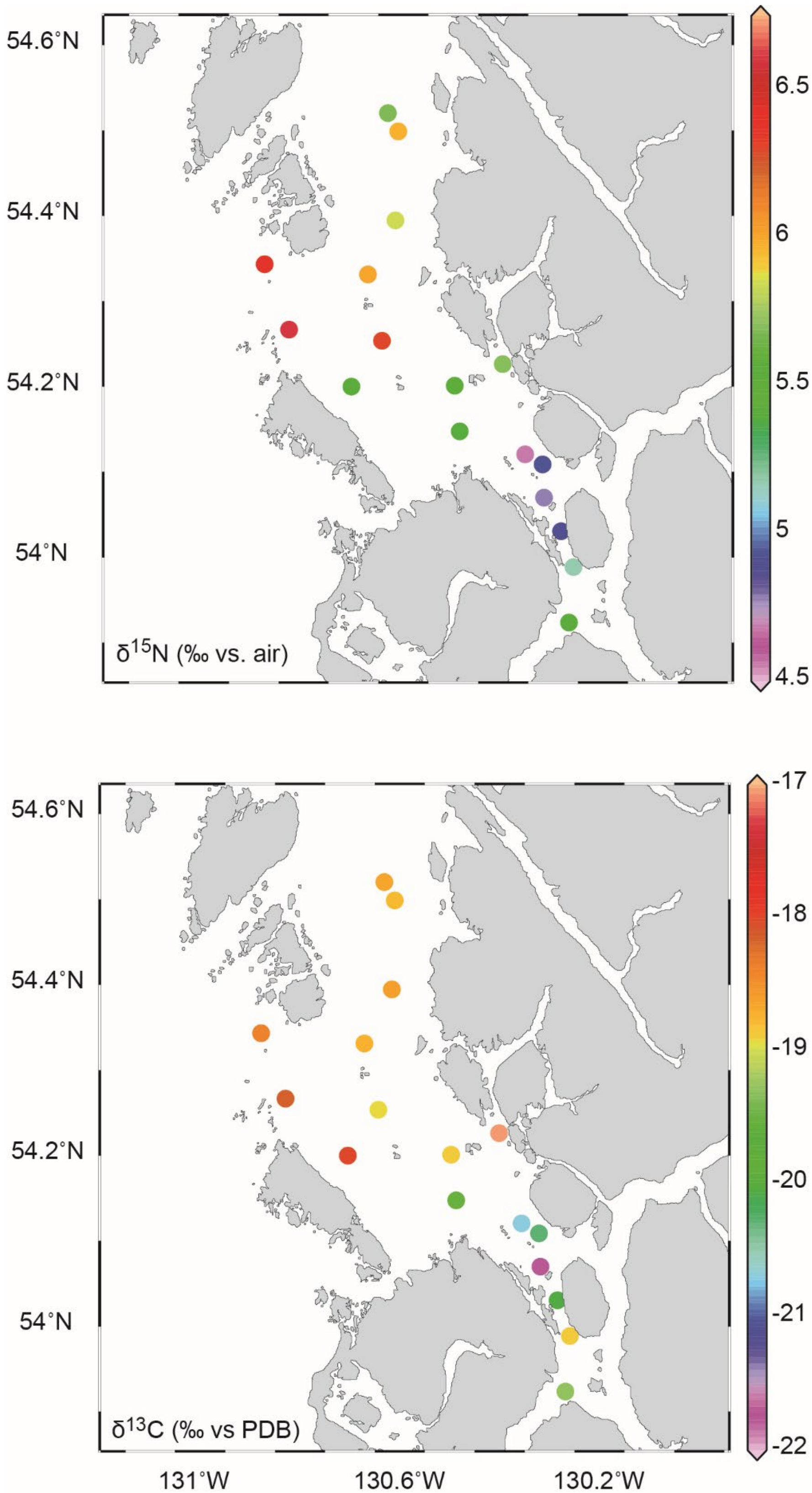

Figure 8 continued. Results of the GFF suspended particulate matter analysis collected on 2018-025, Chatham Sound Region.

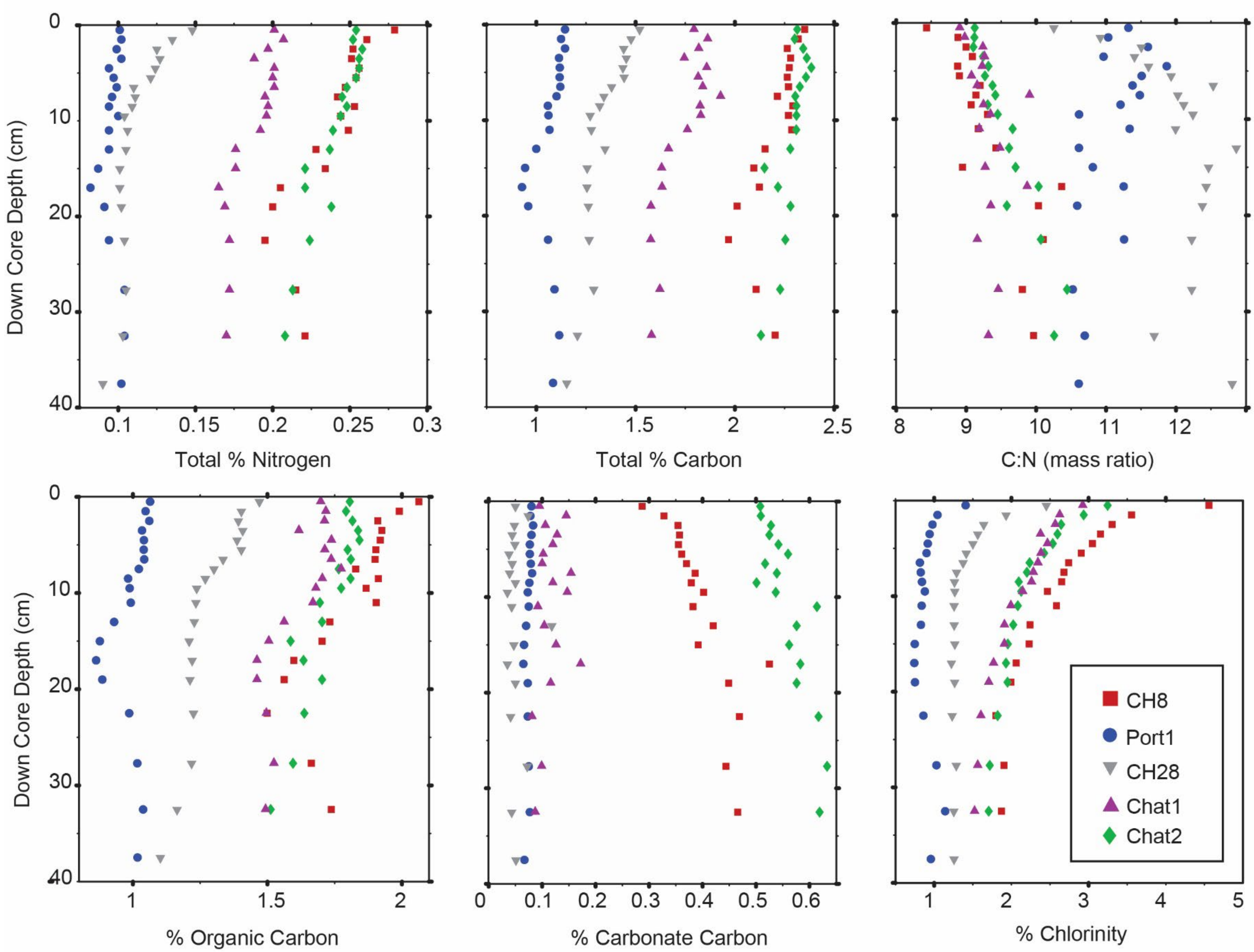

Figure 9. Geochemical results from sediment cores collected during 2018-025, Chatham Sound and Northern Inlet Region.

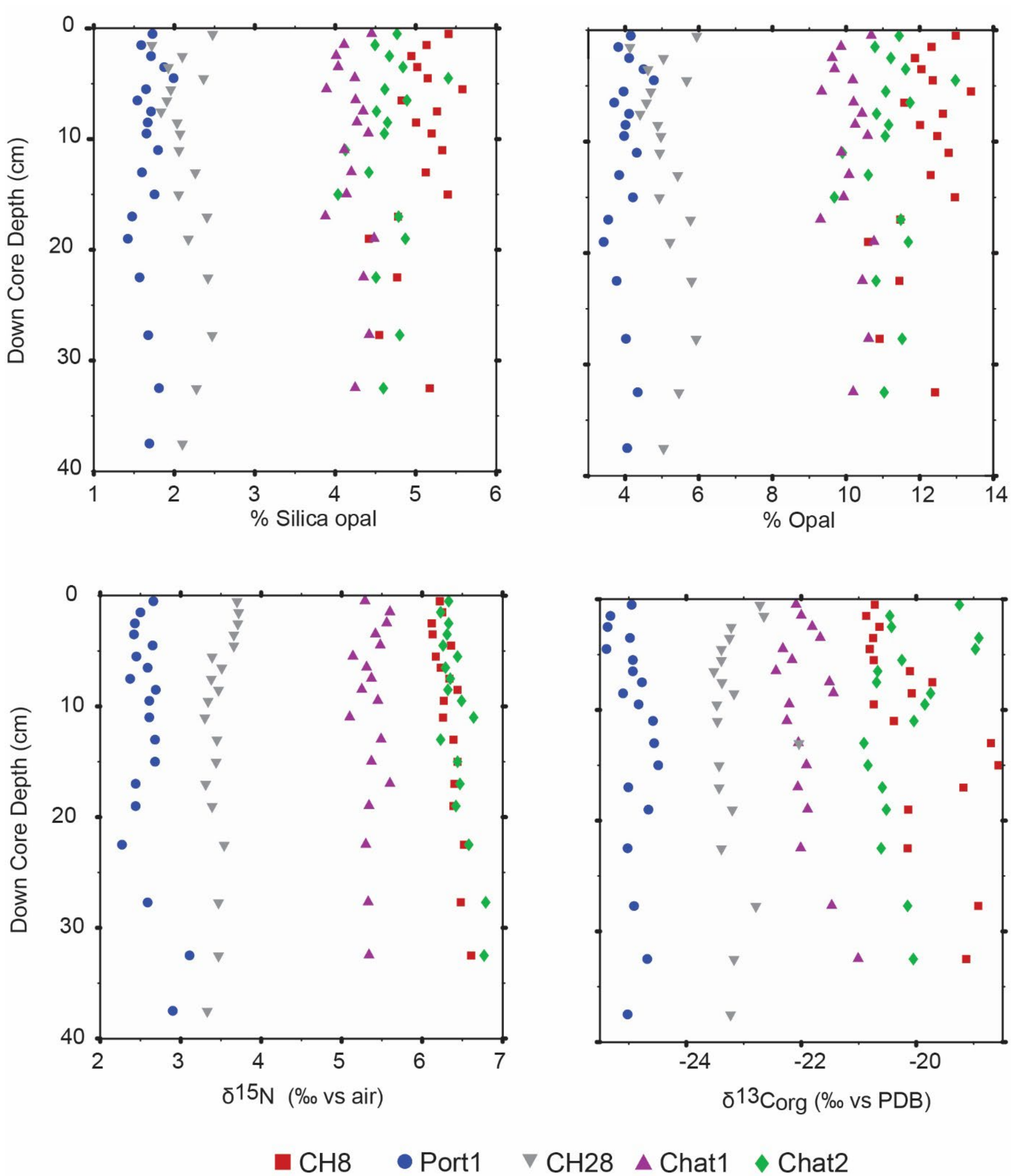

Figure 9 continued. Geochemical results from sediment cores collected during 2018-025, Chatham Sound and Northern Inlet Region.

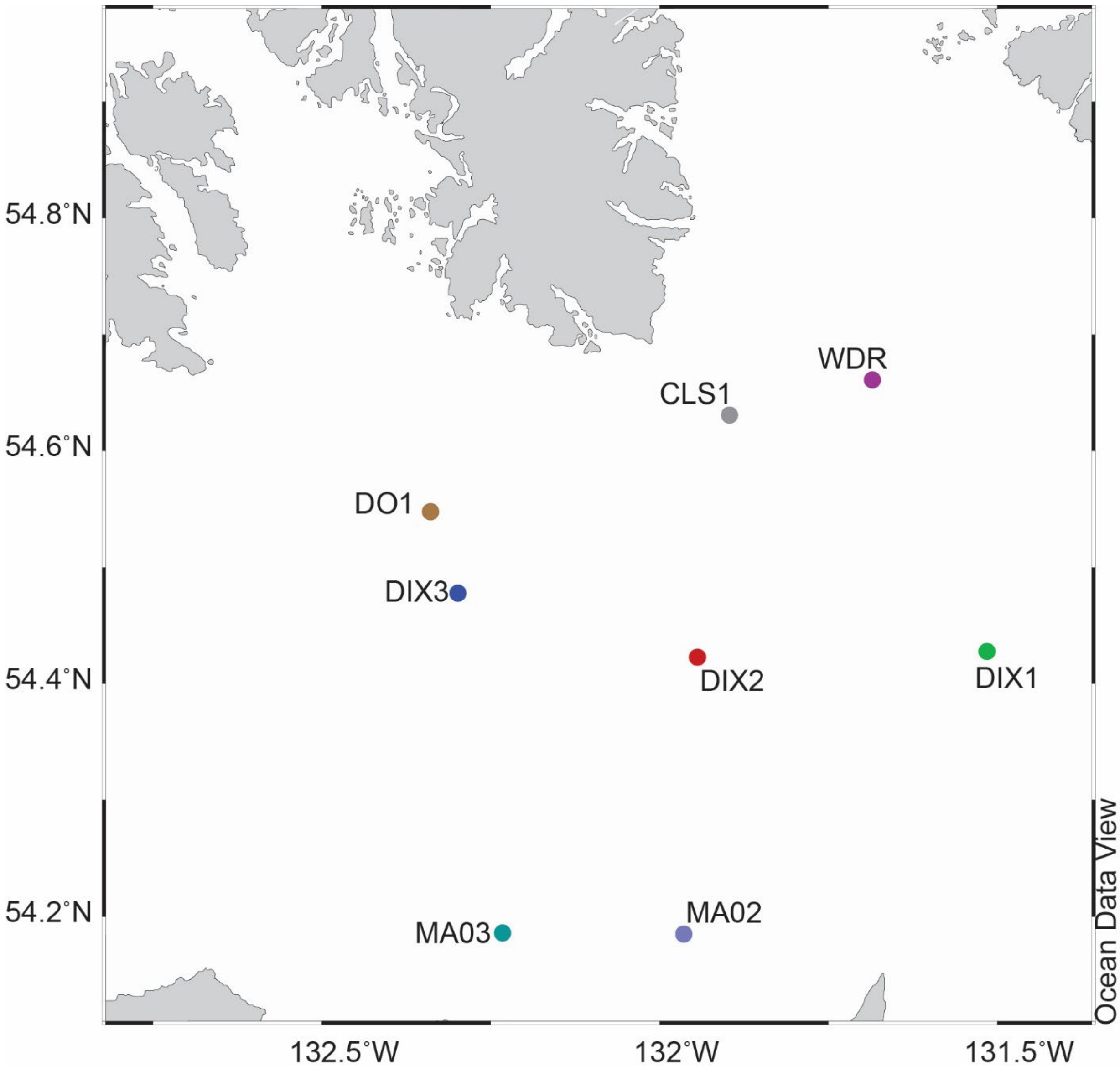

Figure 10. Dixon Entrance Region station map 2018-025.

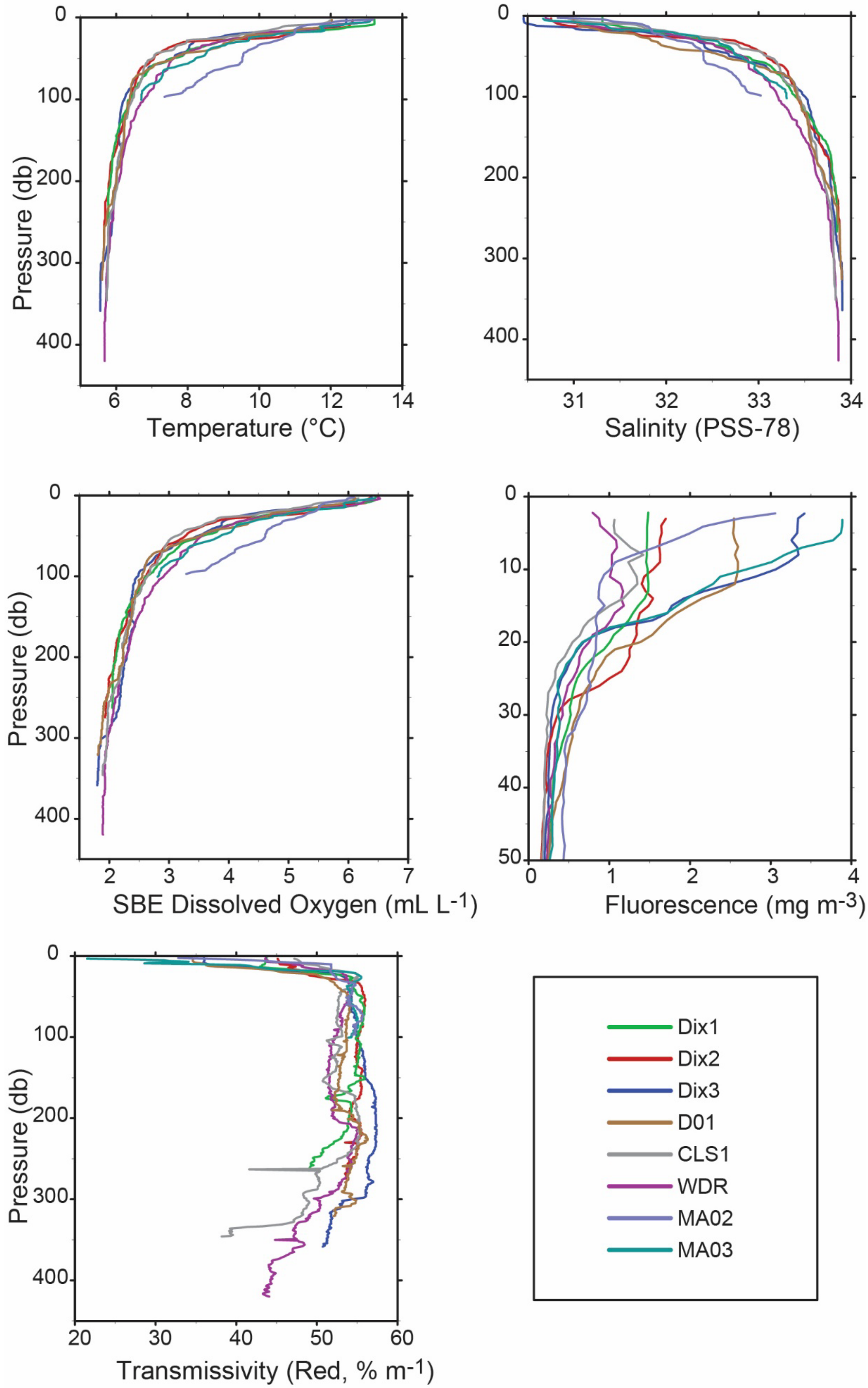

Figure 11. SBE911 data collected during 2018-025, Dixon Entrance Region.

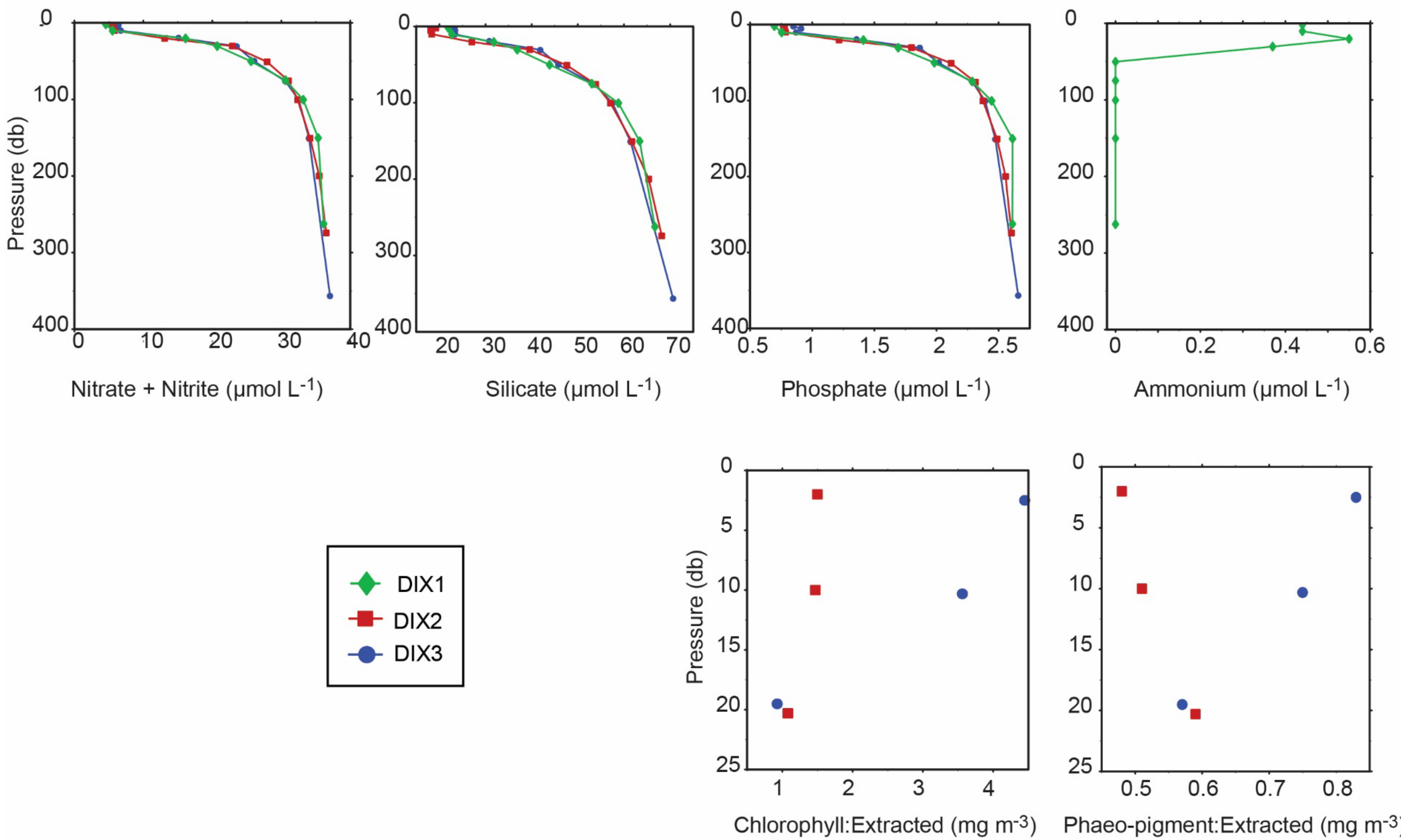

Figure 12. Niskin bottle data collected during 2018-025, Dixon Entrance Region.

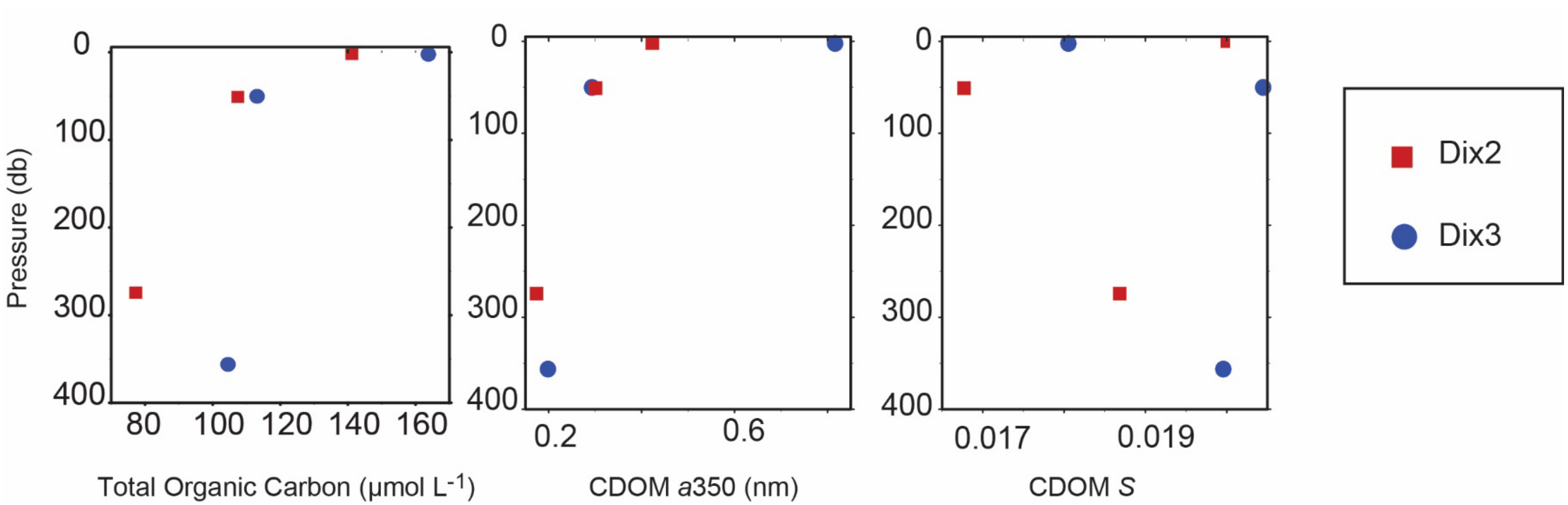

Figure 12 continued. Niskin bottle data collected during 2018-025, Dixon Entrance Region.

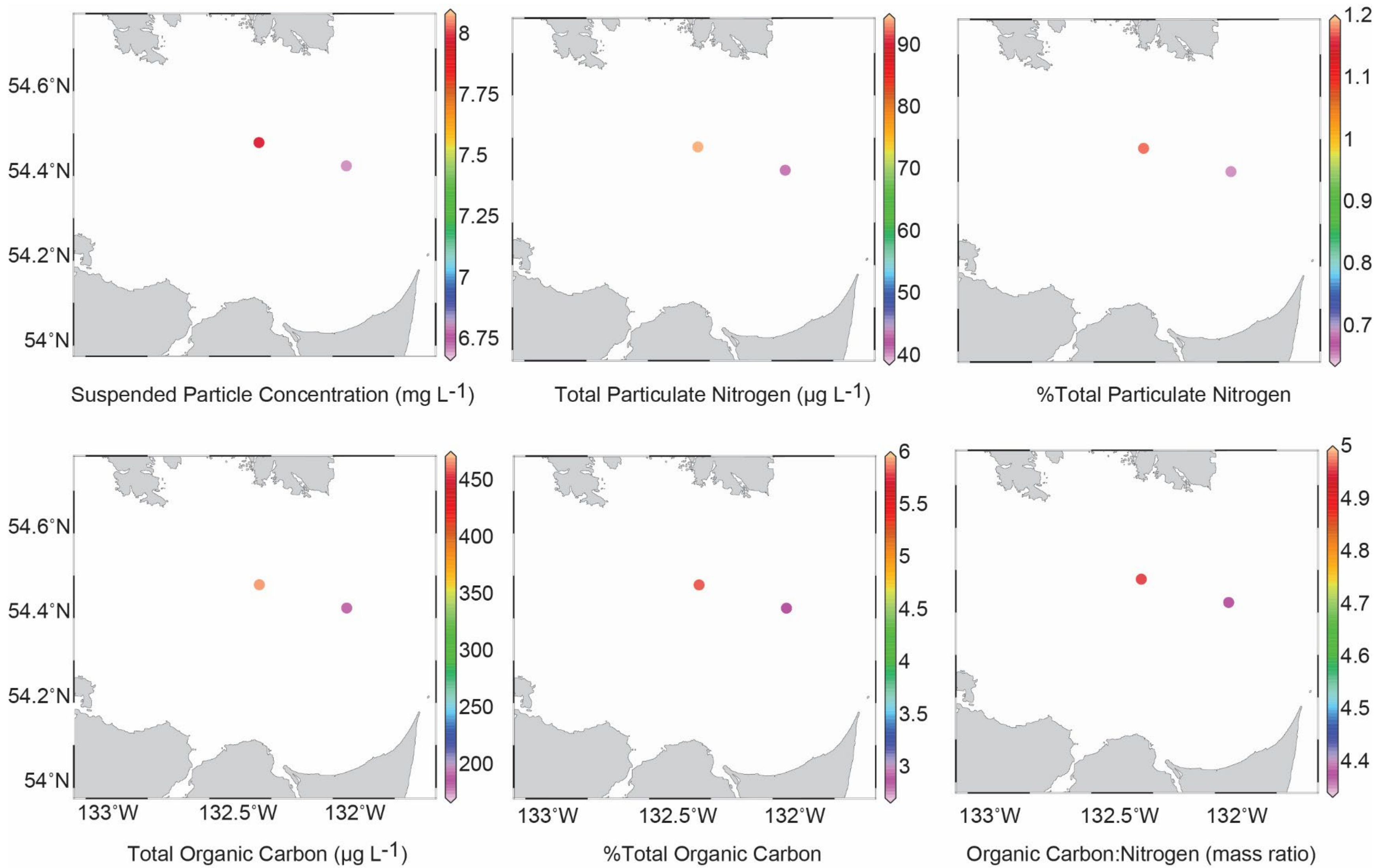

Figure 13. Results of the GFF suspended particulate matter analysis collected on 2018-025, Dixon Entrance Region.

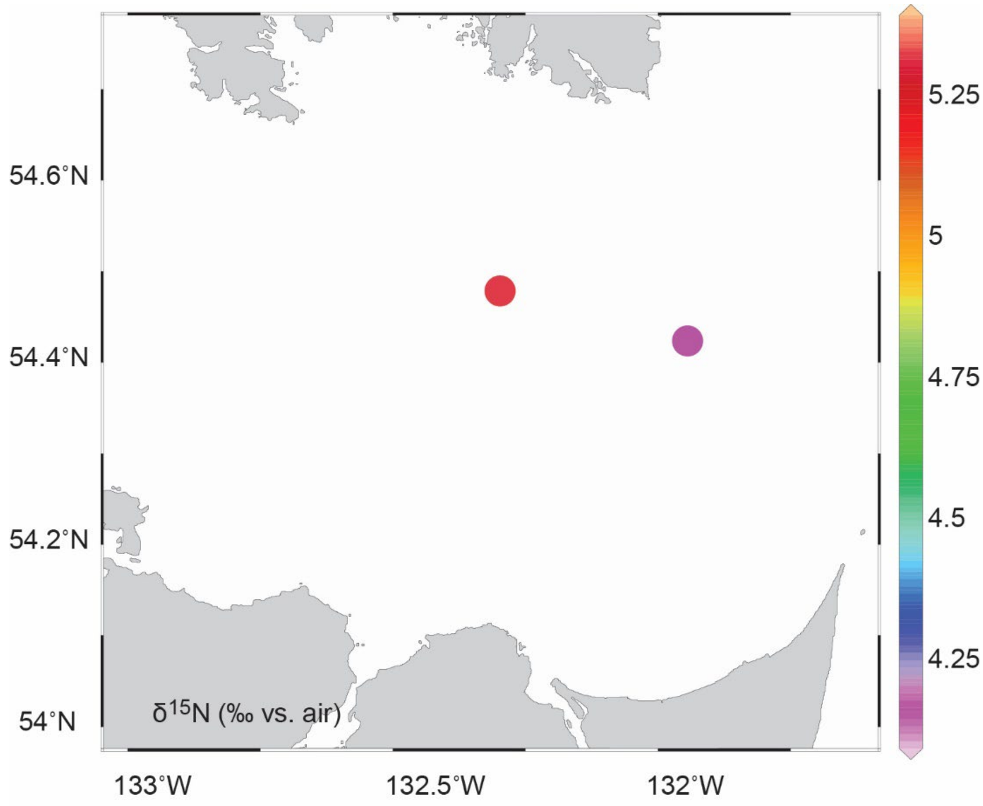

Figure 13 continued. Results of the GFF suspended particulate matter analysis collected on 2018-025, Dixon Entrance Region. Samples for $\delta^{13}C$ were non-detectable.

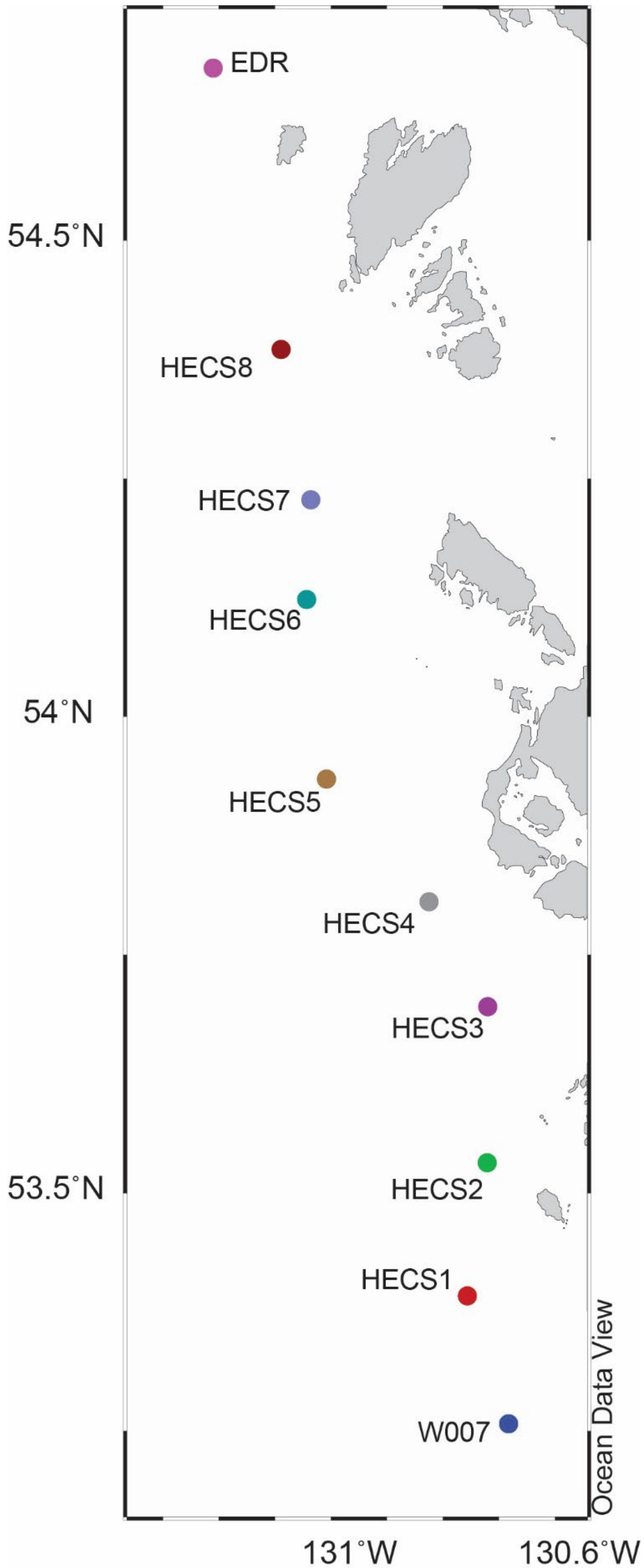

Figure 14. Hecate Strait Region station map, 2018-025.

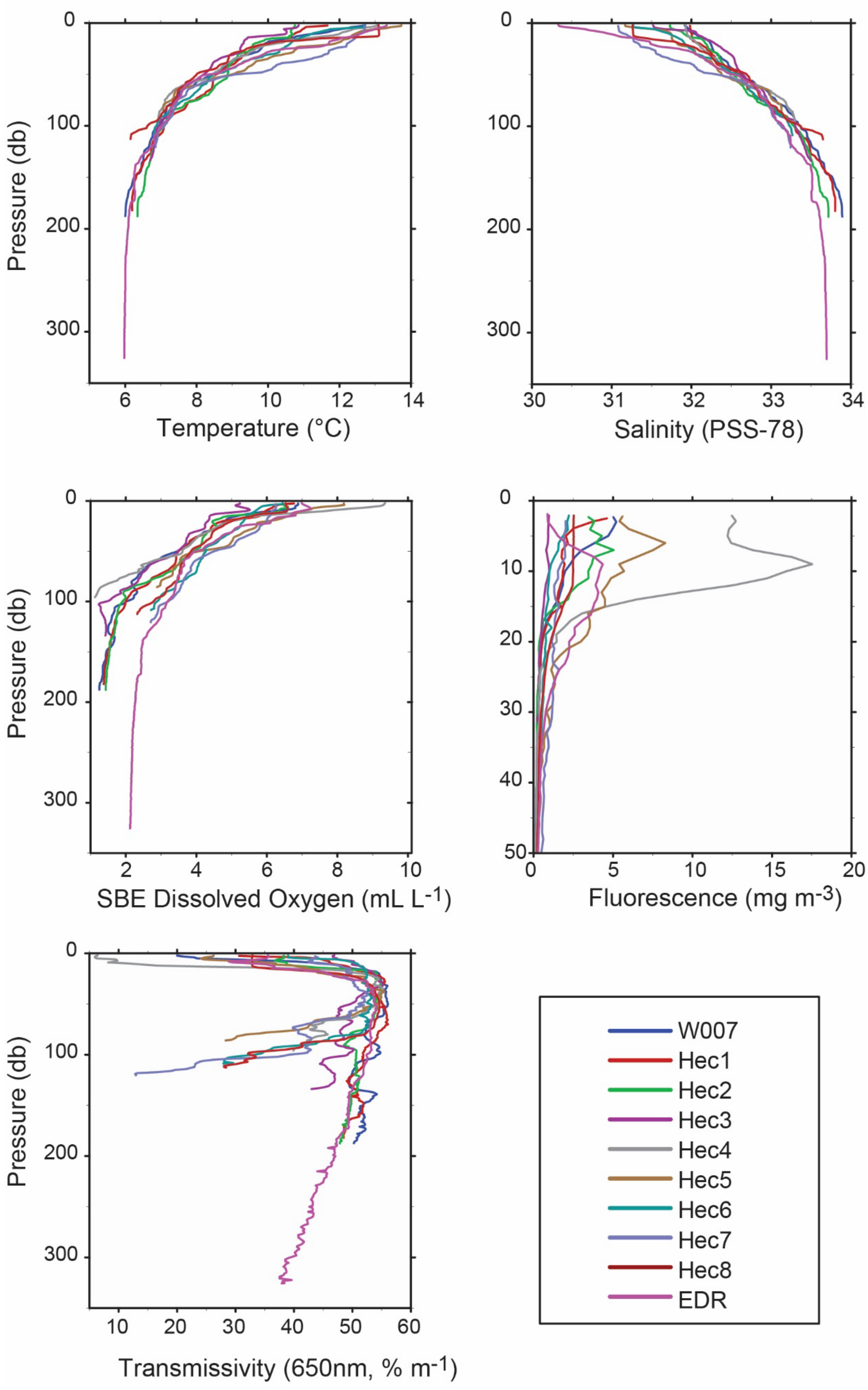

Figure 15. SBE911 data collected during 2018-025, Hecate Strait region.

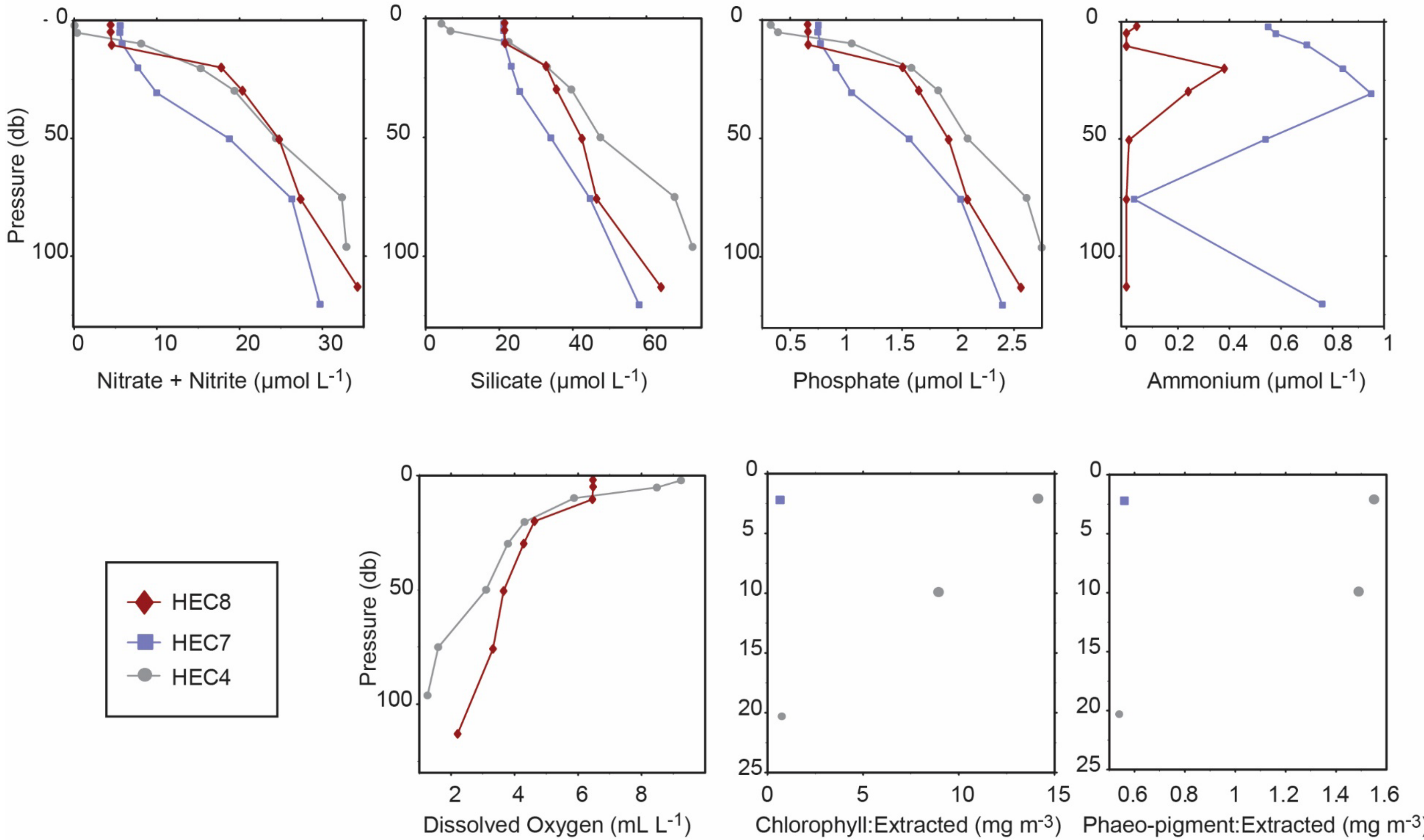

Figure 16. Niskin bottle data collected during 2018-025, Hecate Strait region.

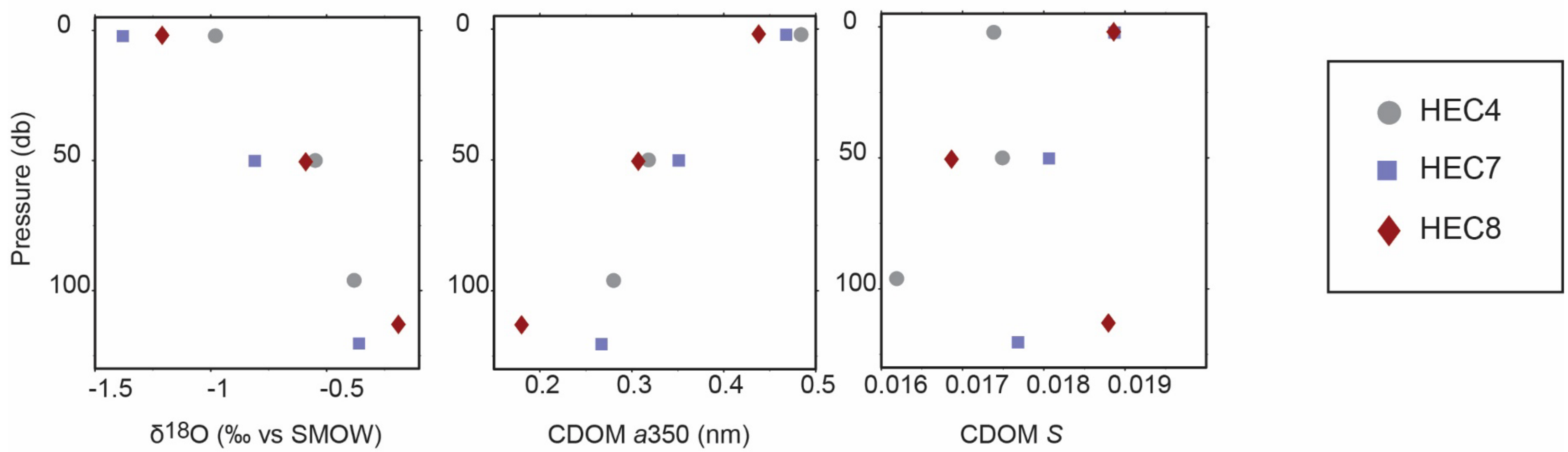

Figure 16 continued. Niskin bottle data collected during 2018-025, Hecate Strait region.

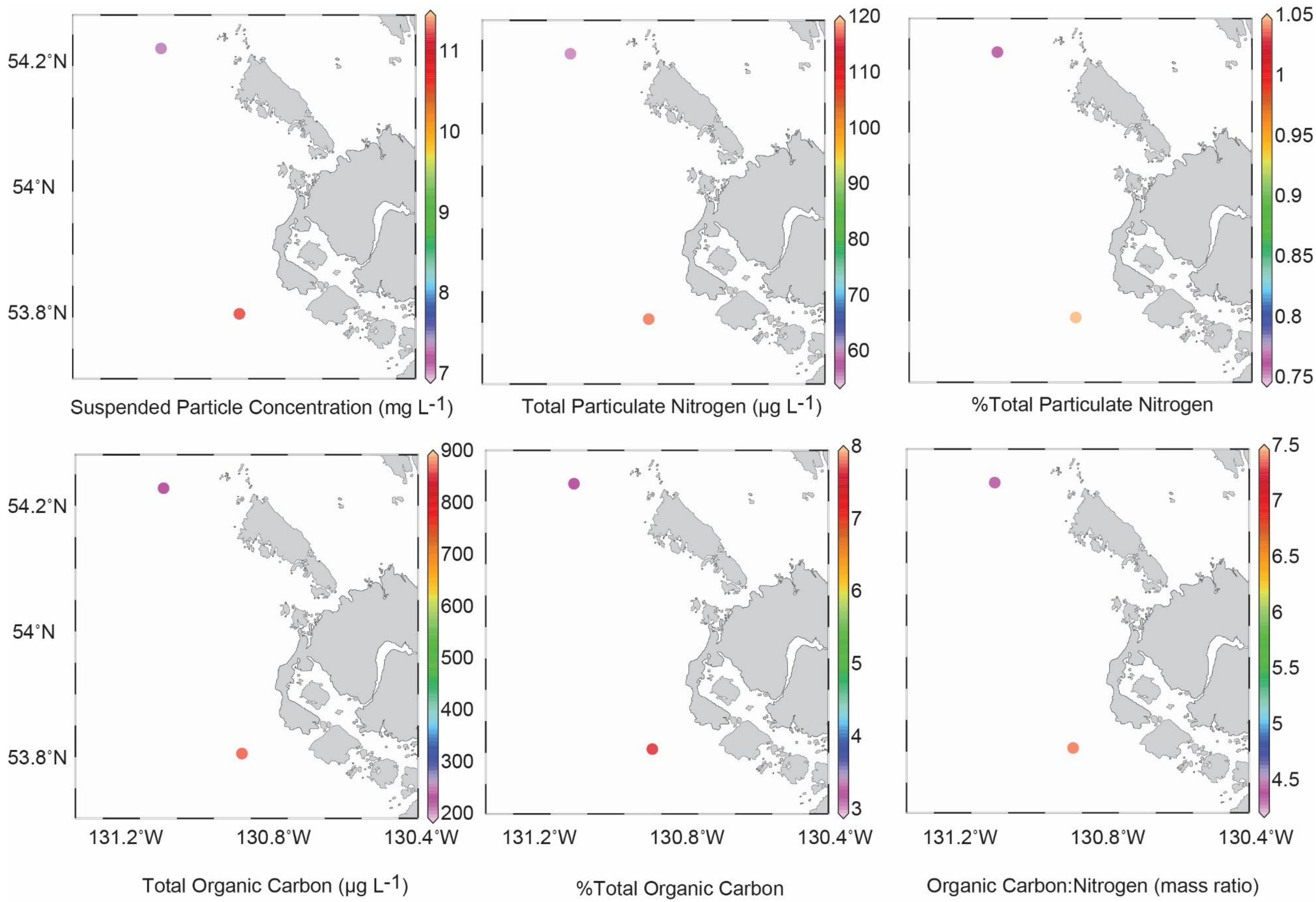

Figure 17. Results of the GFF suspended particulate matter analysis on 2018-025, Hecate Strait Region.

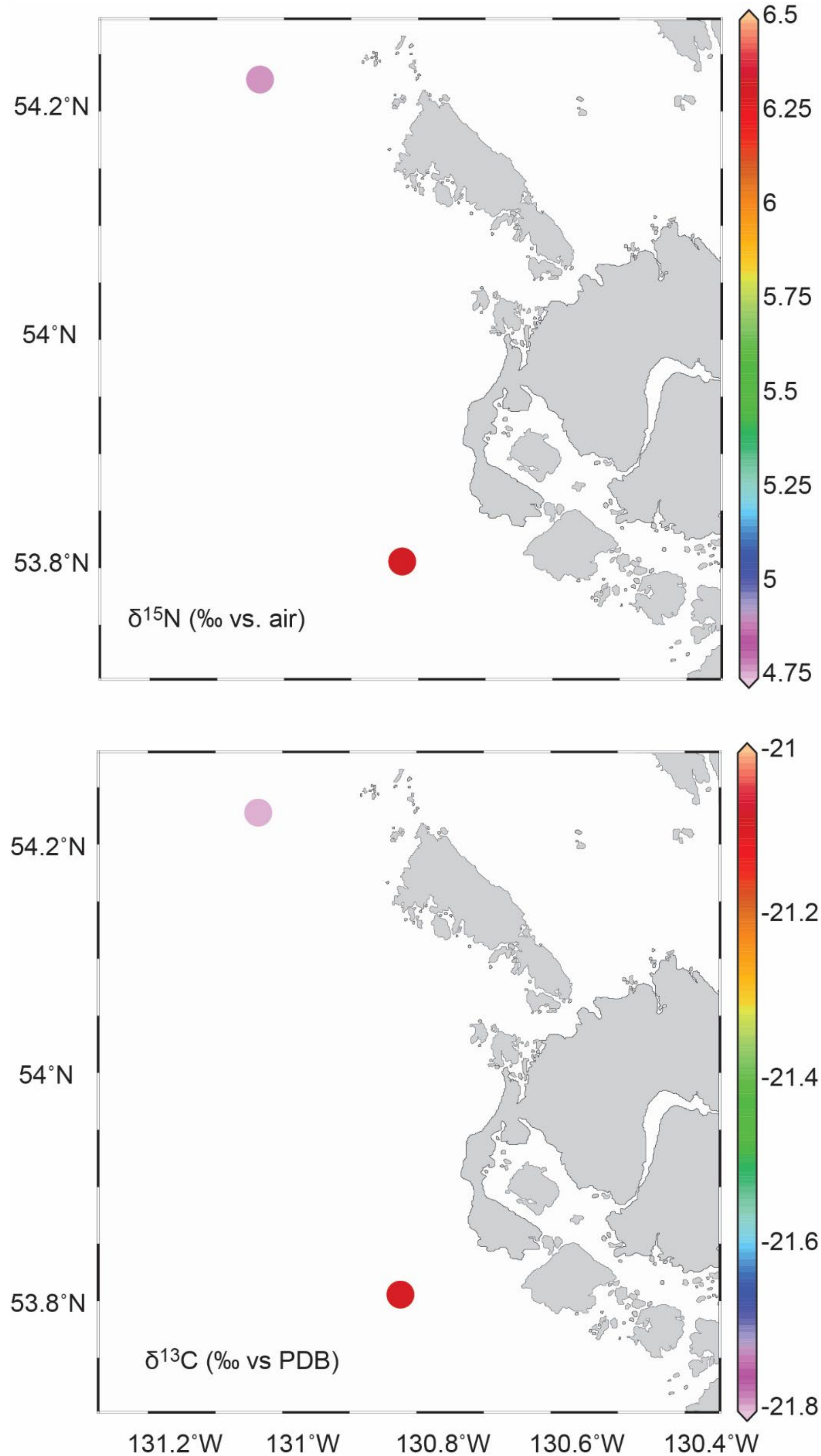

Figure 17 continued. Results of the GFF suspended particulate matter analysis on 2018-025, Hecate Strait region.

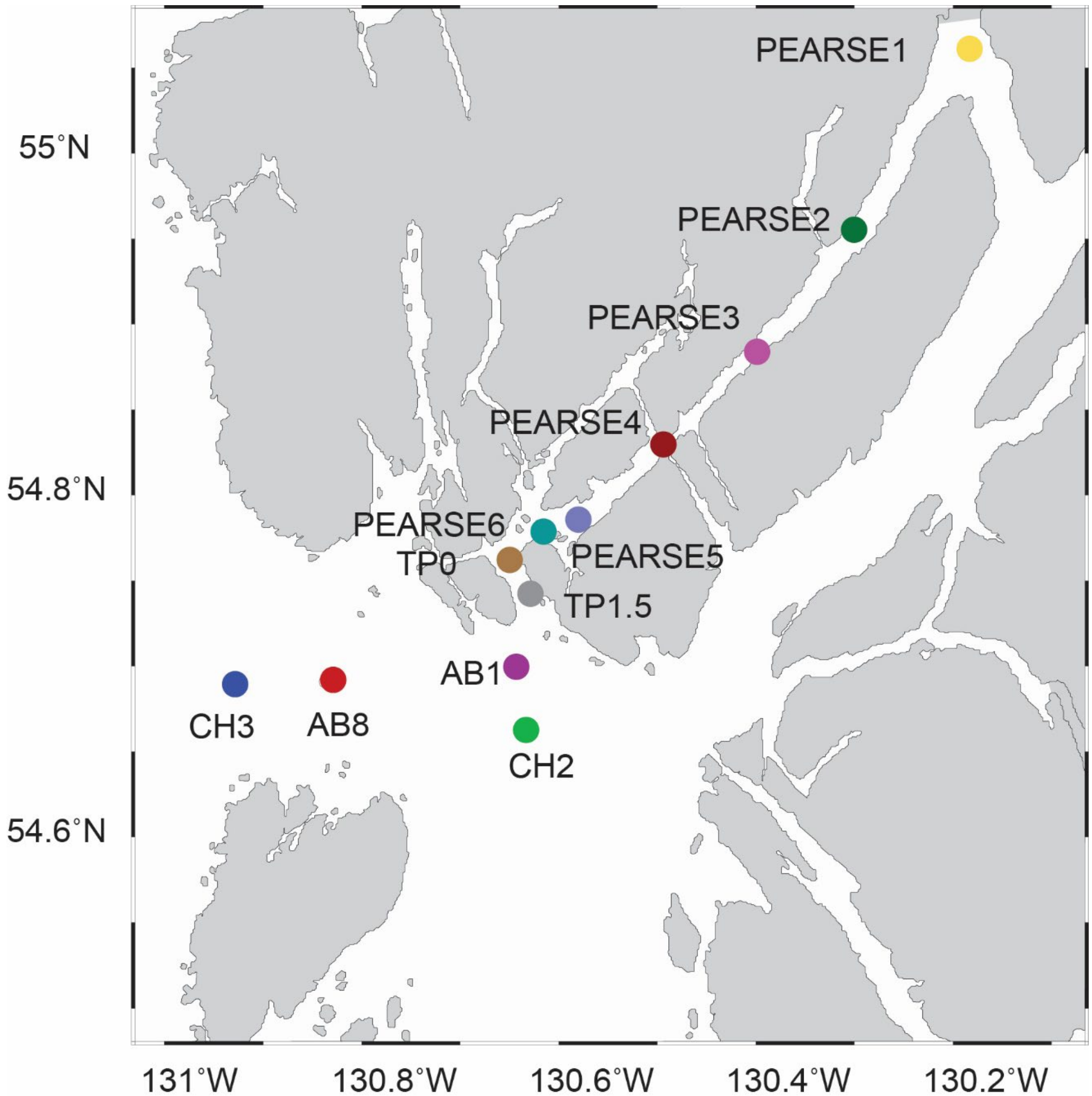

Figure 18. Pearse Inlet Region station map, 2018-025.

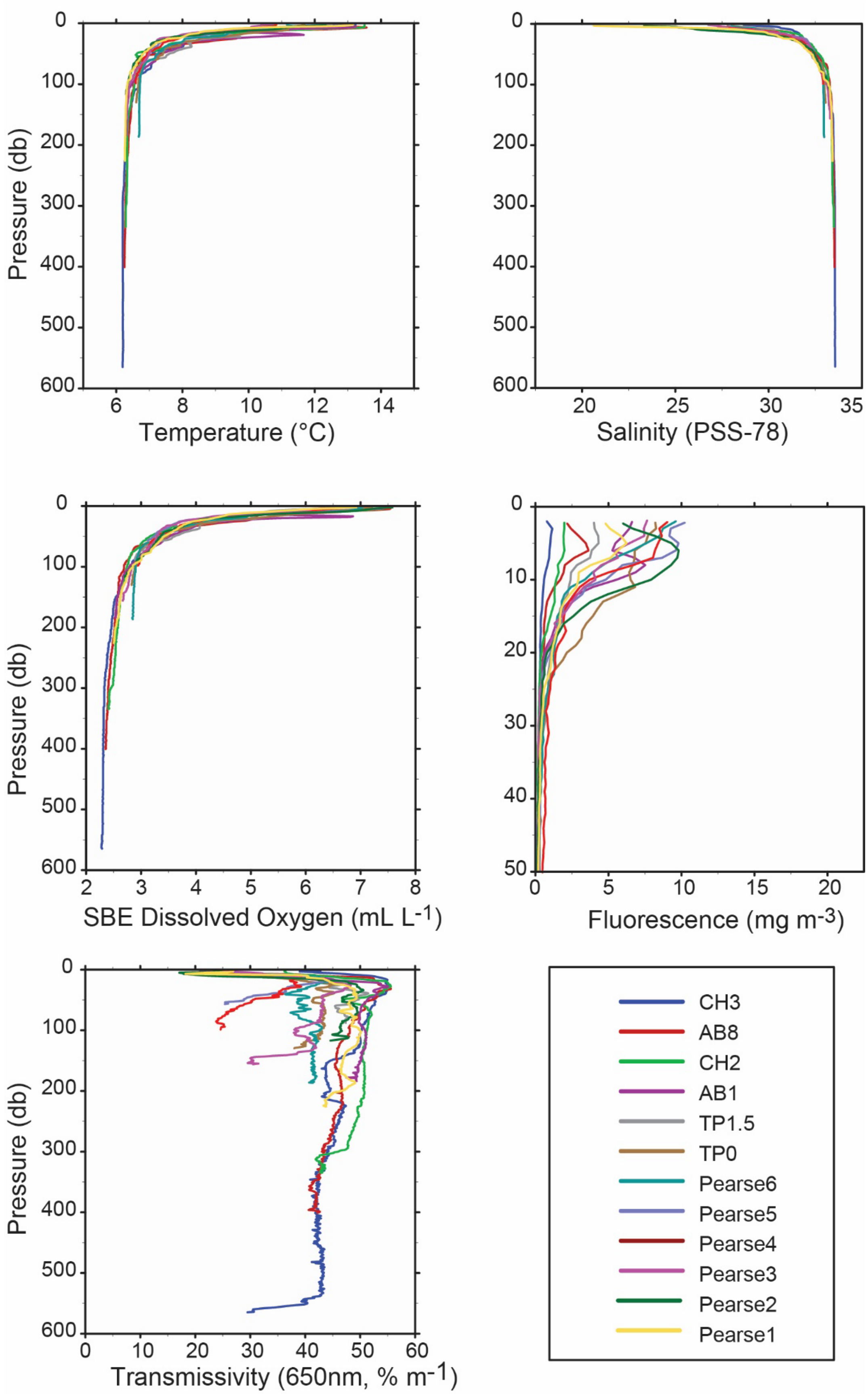

Figure 19. SBE911 data collected during 2018-025, Pearse Inlet Region.

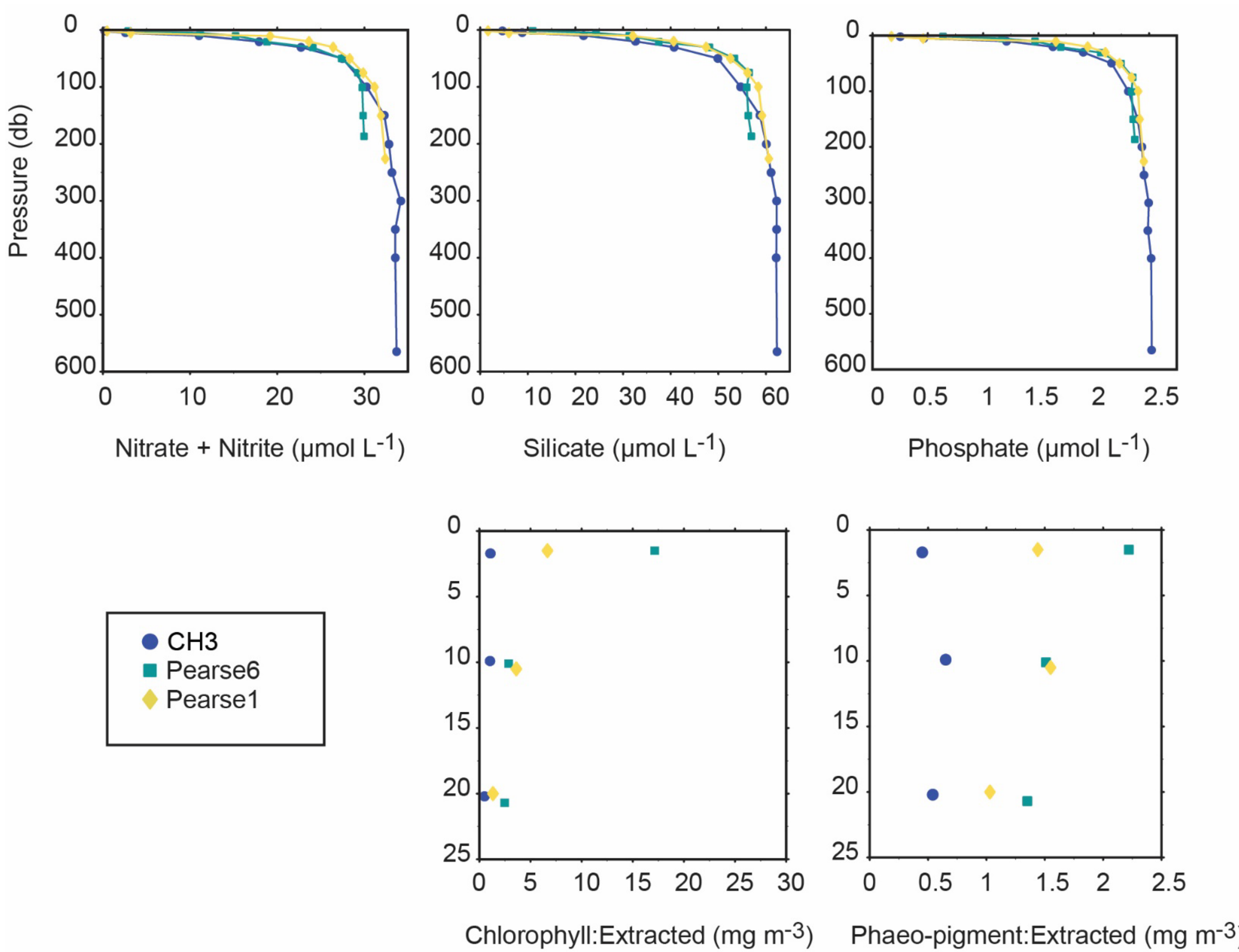

Figure 20. Niskin bottle data collected during 2018-025, Pearse Inlet Region.

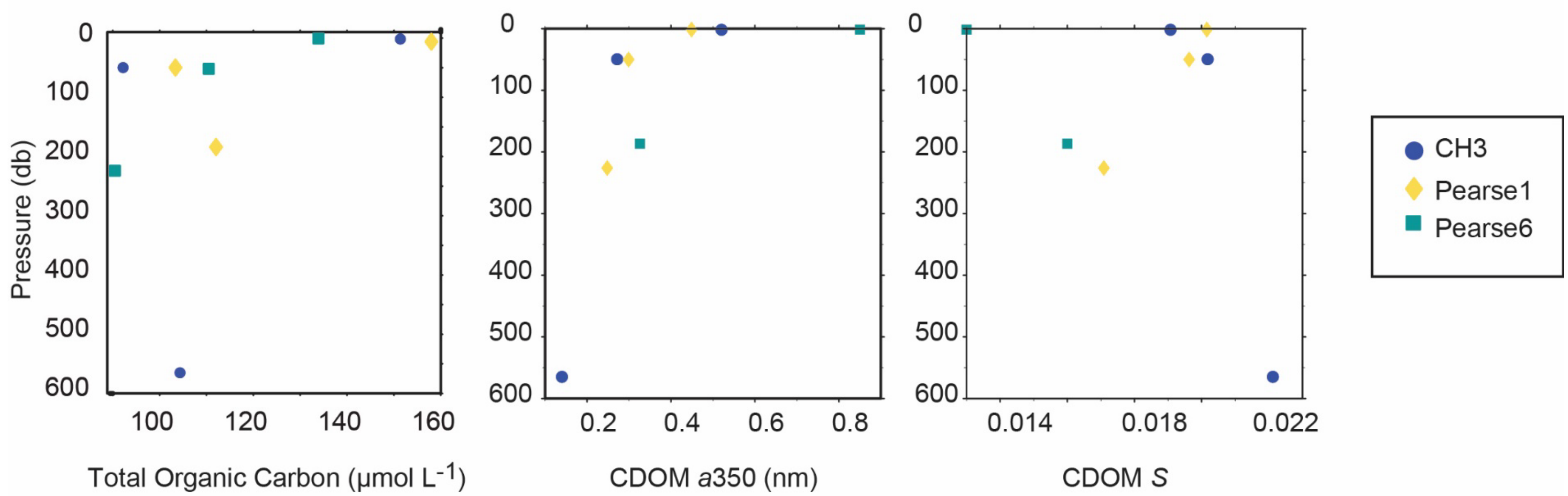

Figure 20 continued. Niskin bottle data collected during 2018-025, Pearse Inlet Region.

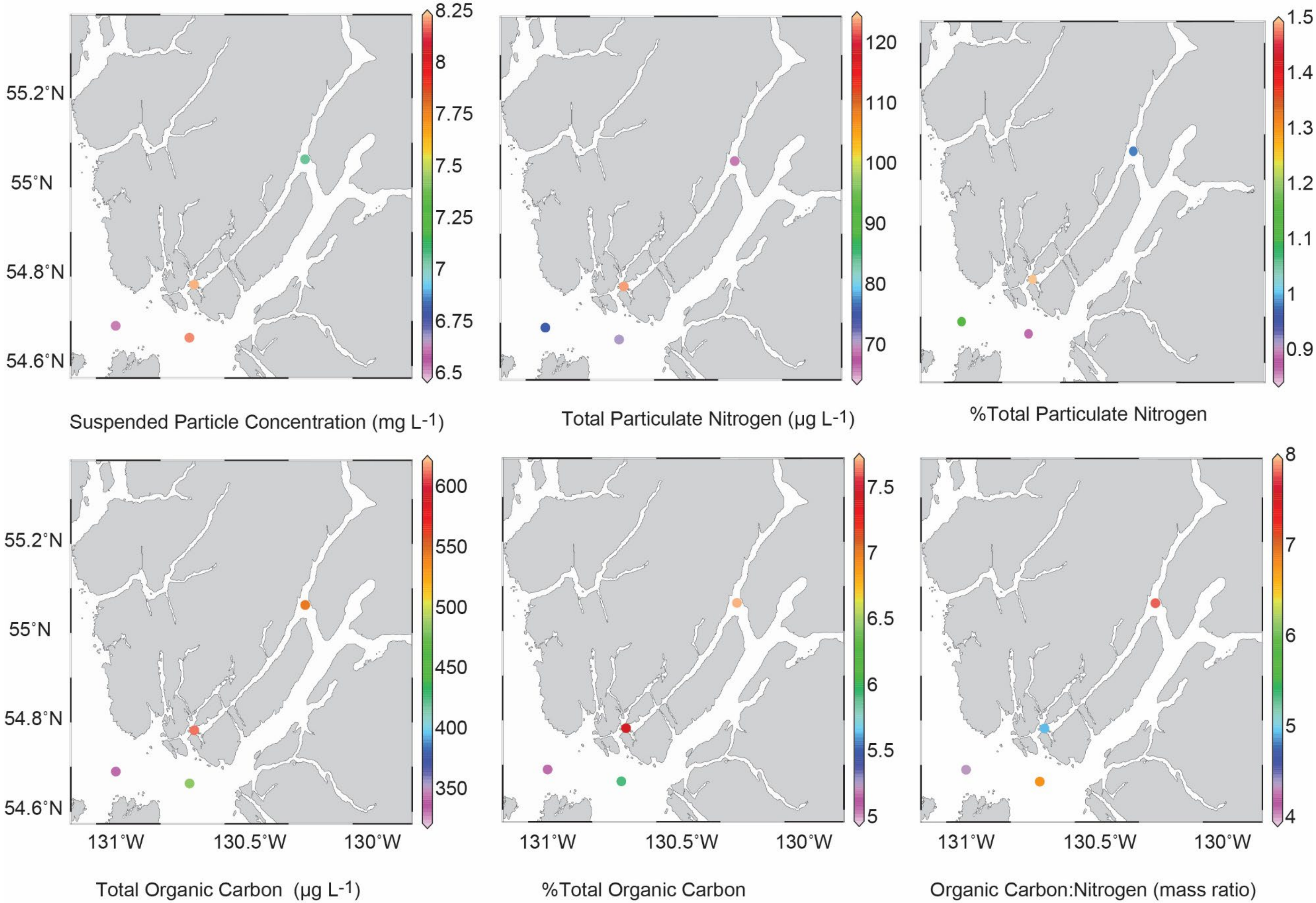

Figure 21. Results of the GFF suspended particulate matter analysis collected on 2018-025, Pearse Inlet Region

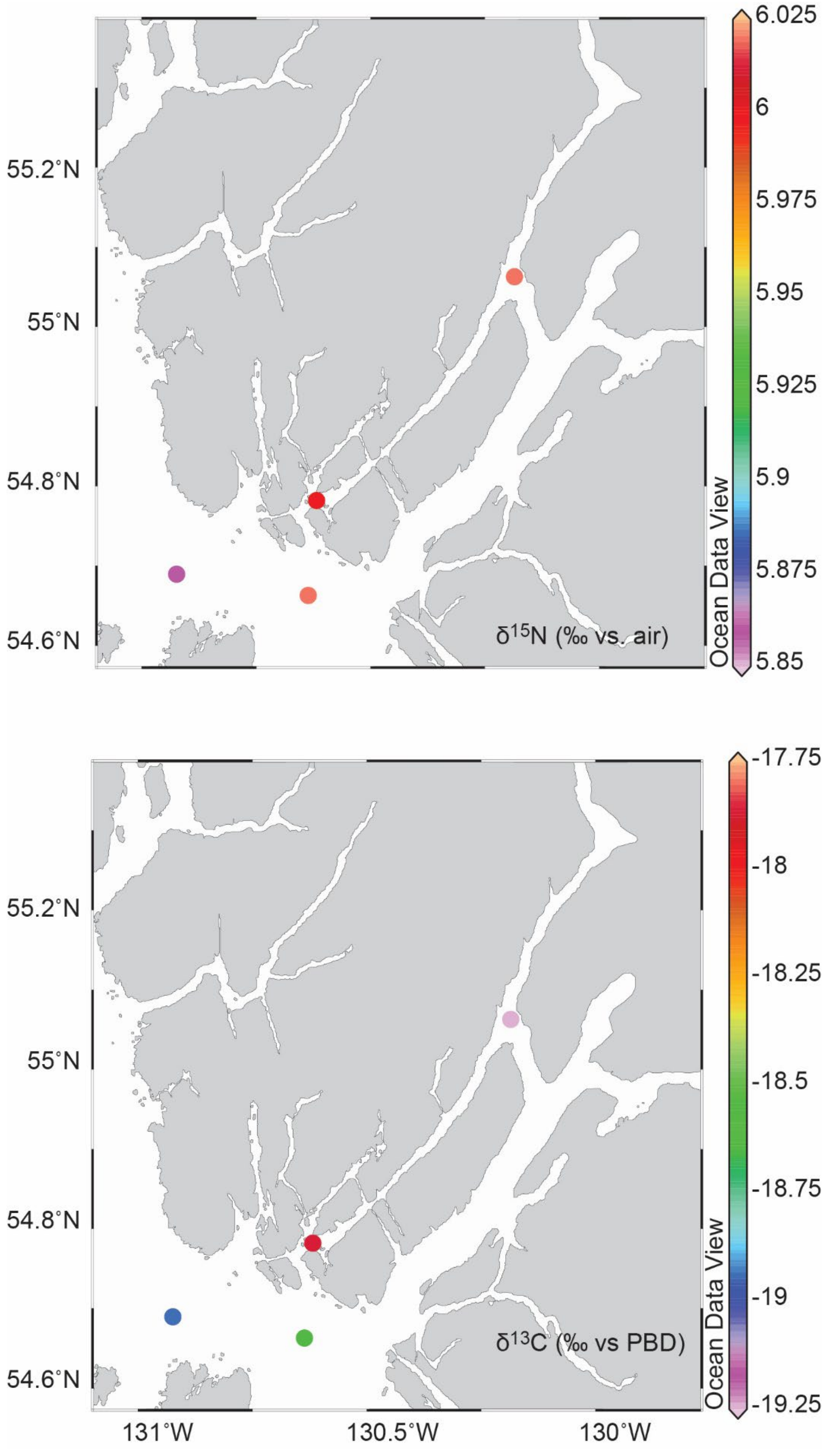

Figure 21 continued. Results of the GFF suspended particulate matter analysis collected on 2018-025, Pearse Inlet Region.

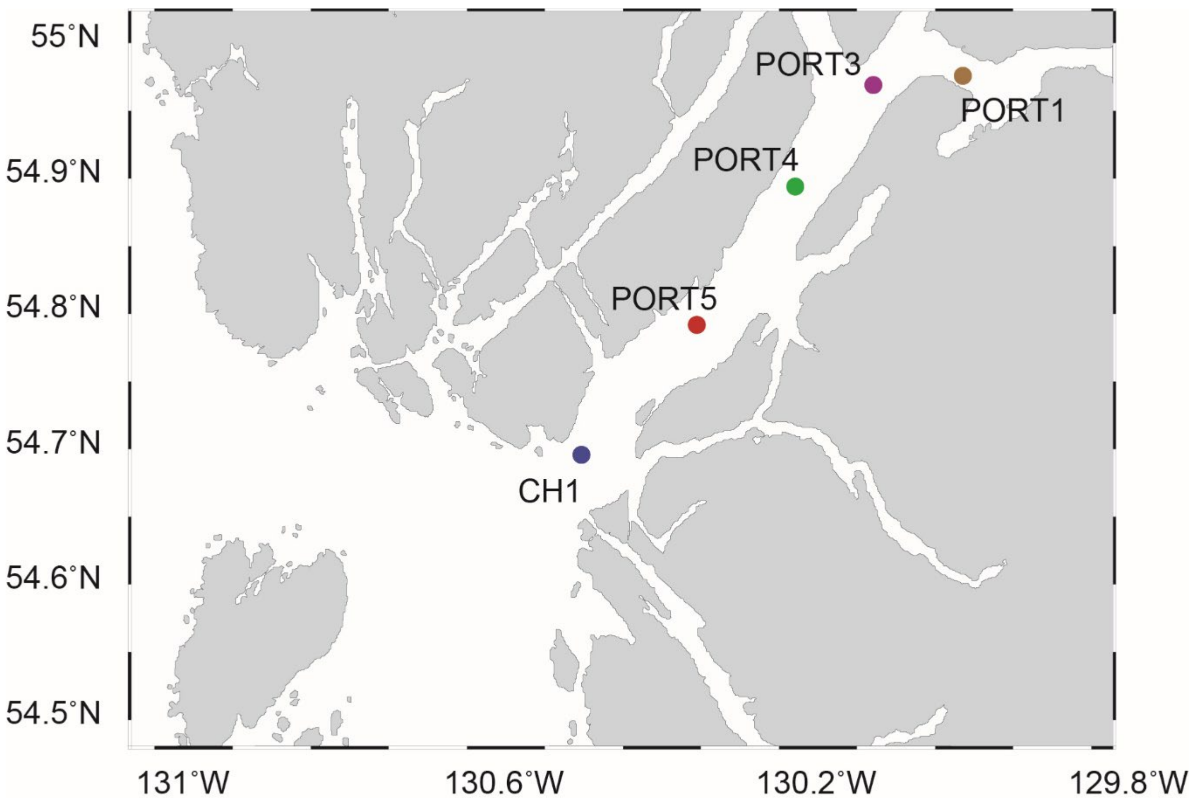

Figure 22. Portland Inlet Region station map, 2018-025.

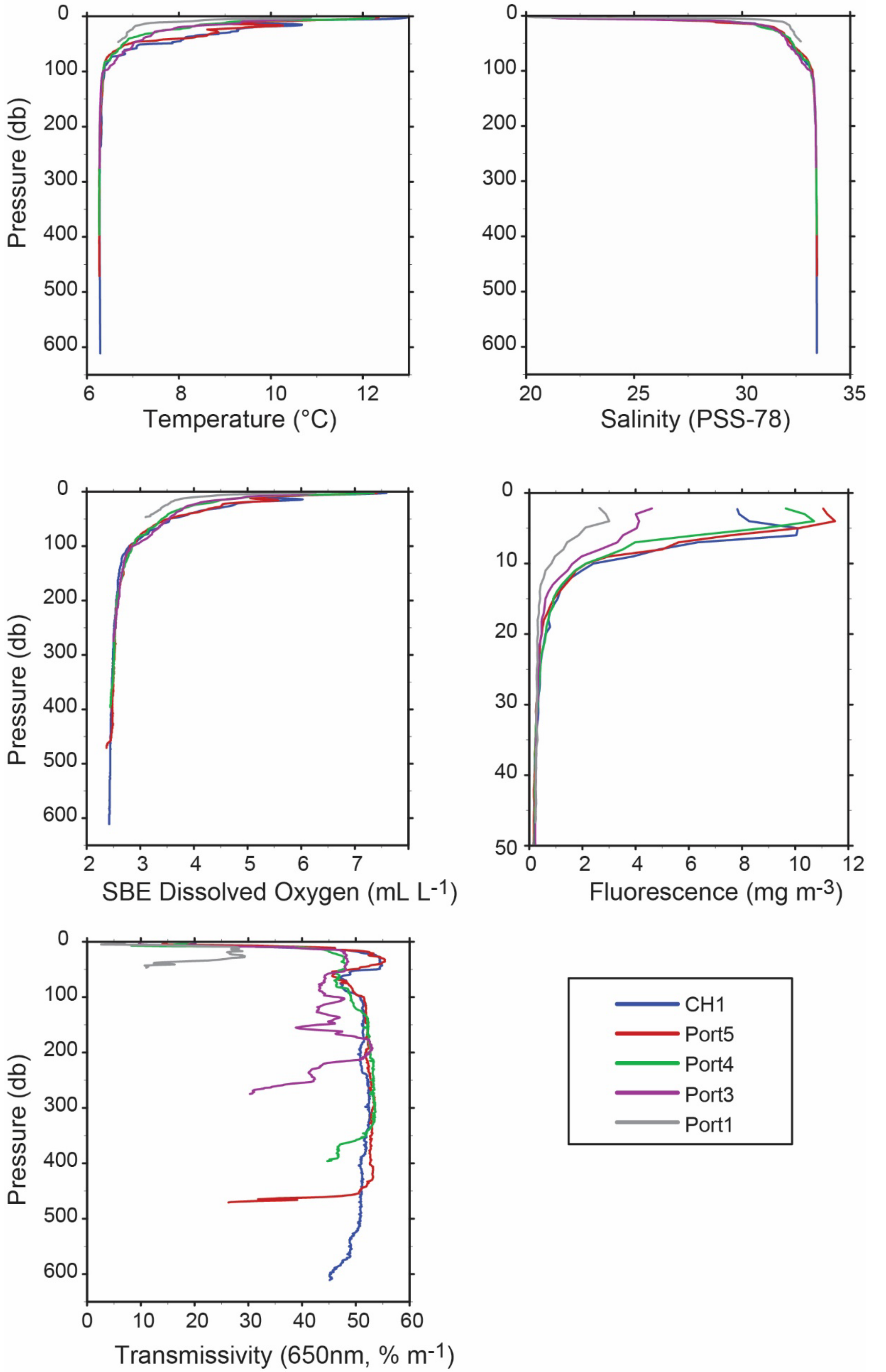

Figure 23. SBE911 data collected during 2018-025, Portland Inlet Region.

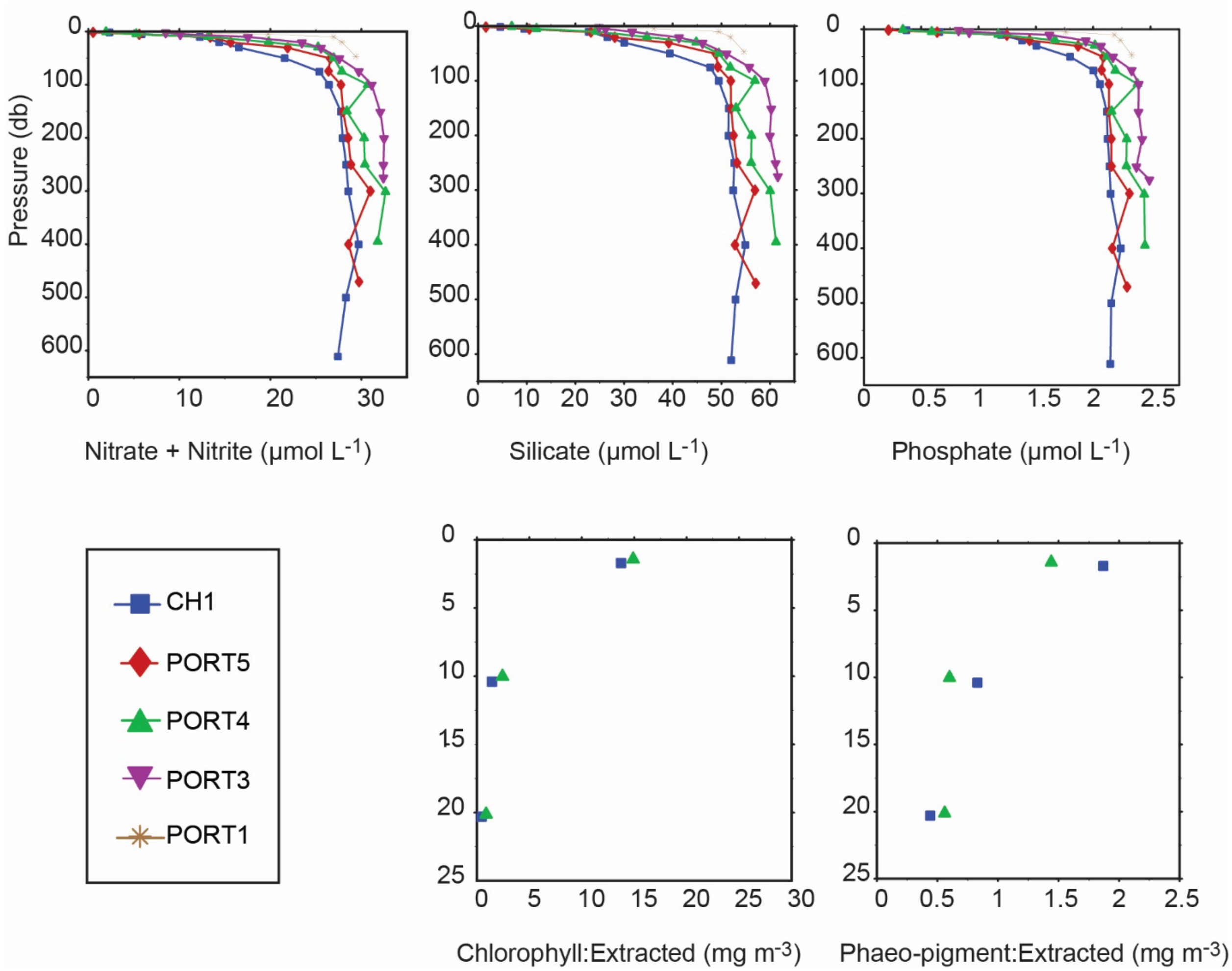

Figure 24. Niskin bottle data collected during 2018-025, Portland Inlet Region.

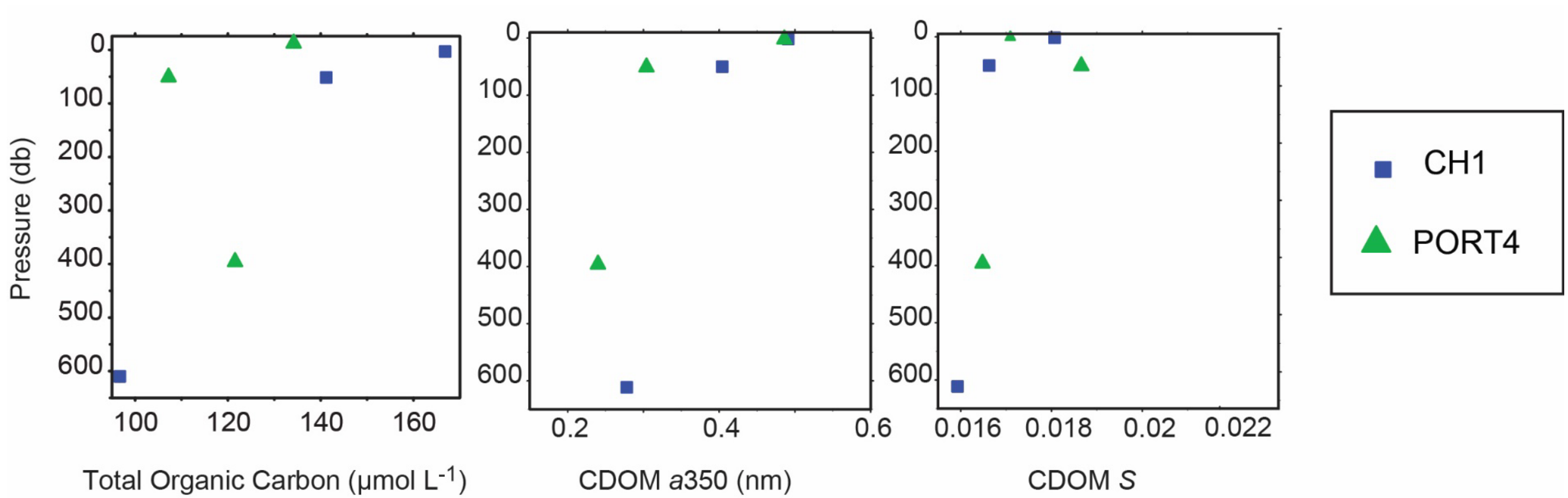

Figure 24 continued. Niskin bottle data collected during 2018-025, Portland Inlet Region.

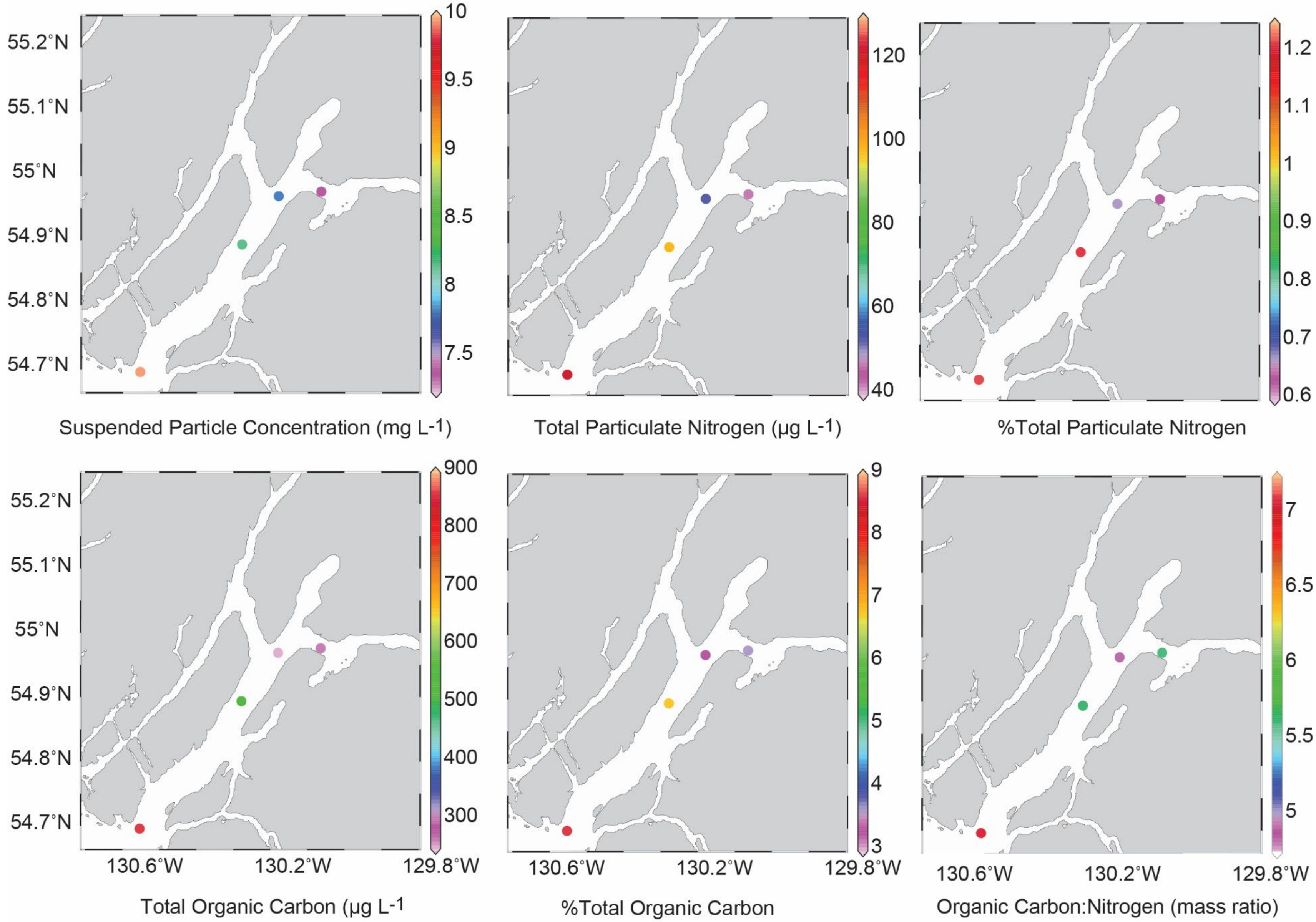

Figure 25. Results of the GFF suspended particulate matter analysis collected on 2018-025, Portland Inlet Region.

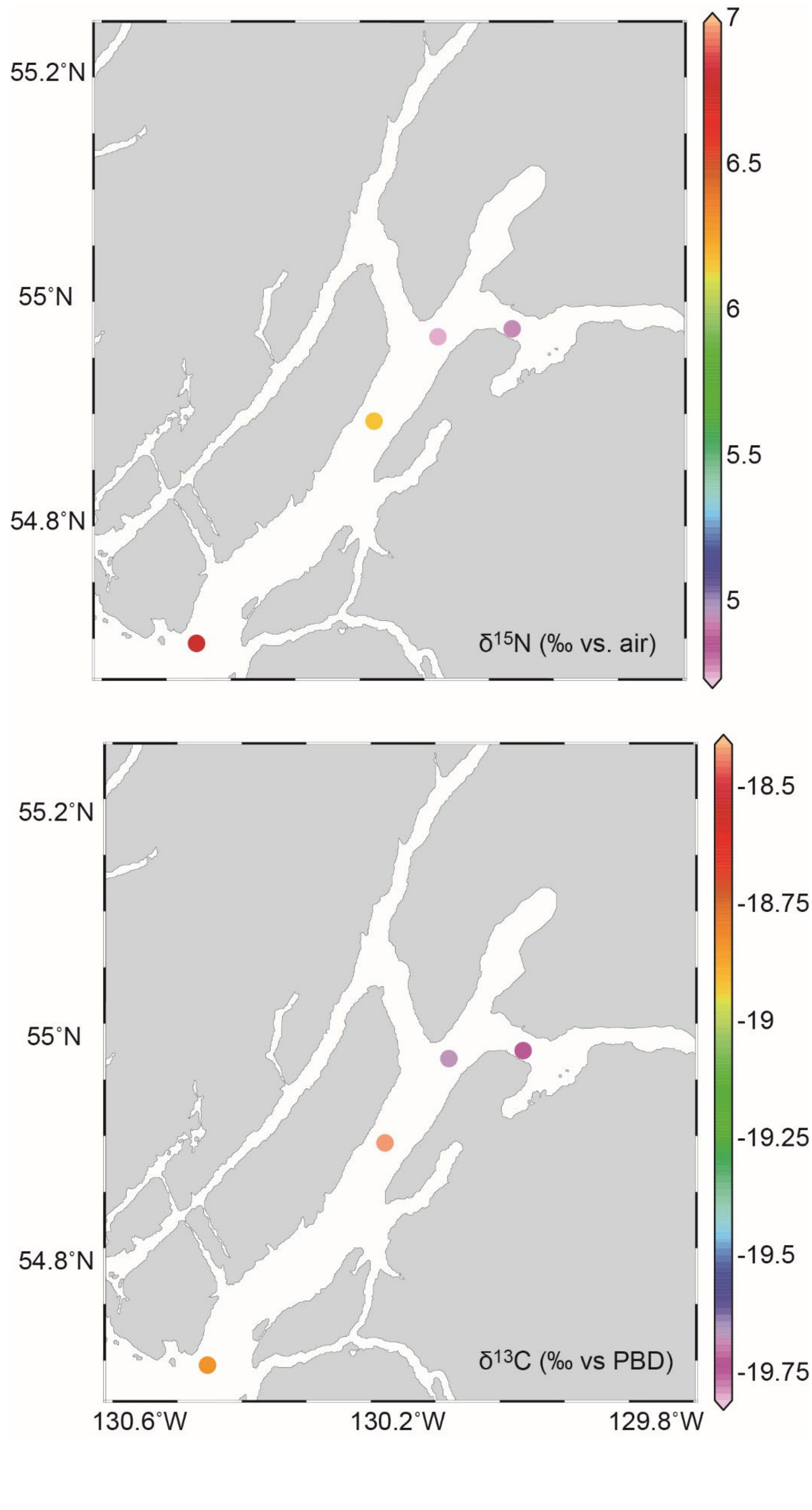

Figure 25 continued. Results of the GFF suspended particulate matter analysis collected on 2018-025, Portland Inlet Region.

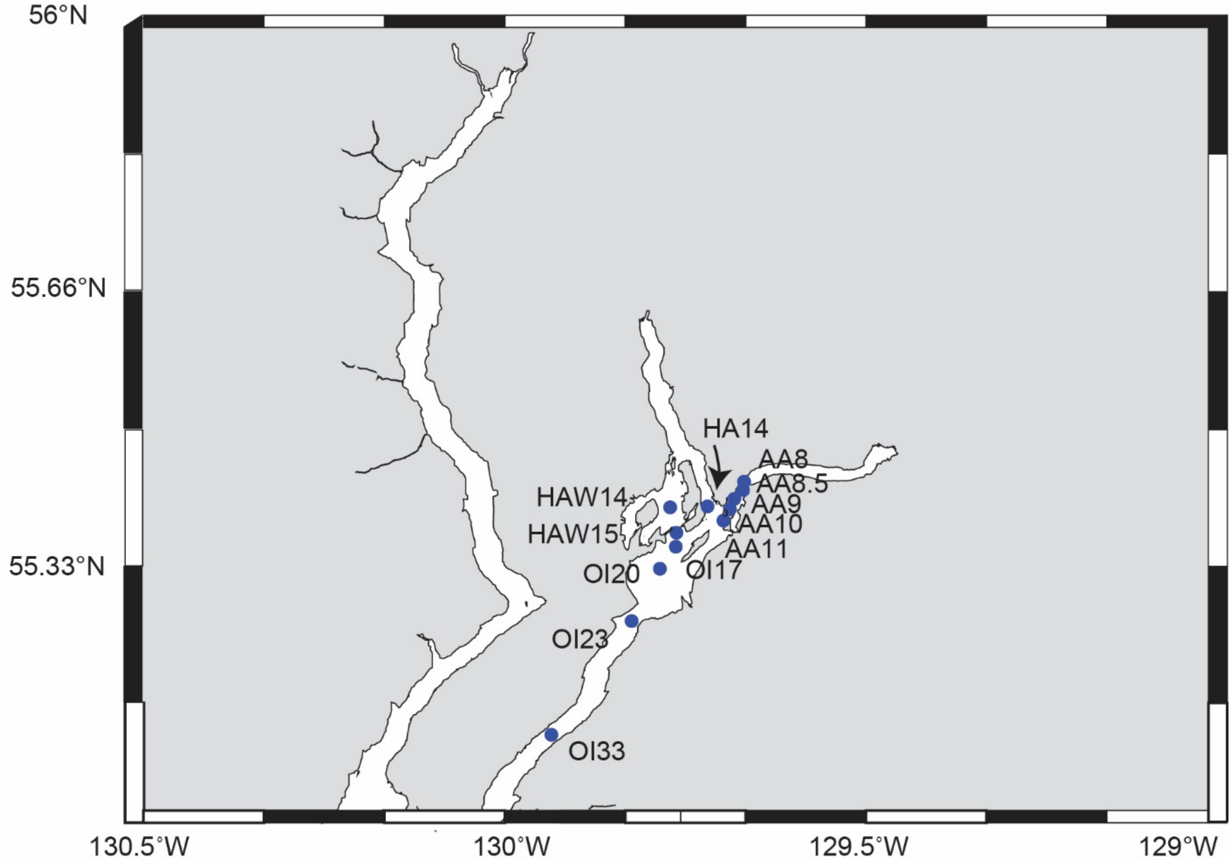

Figure 26. Observatory Inlet Region station map, 2018-025.

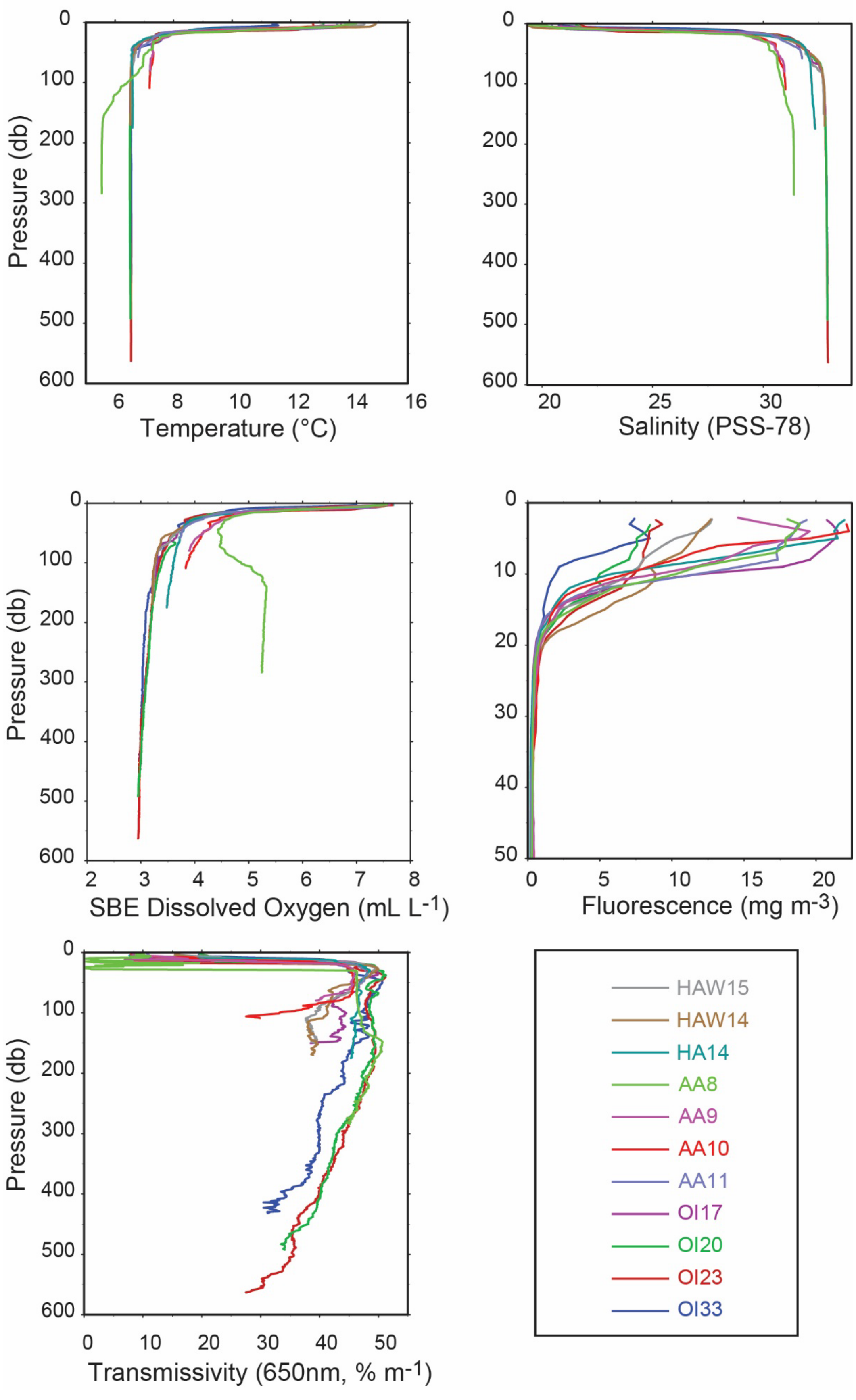

Figure 27. SBE911 data collected during 2018-025, Observatory Inlet Region.

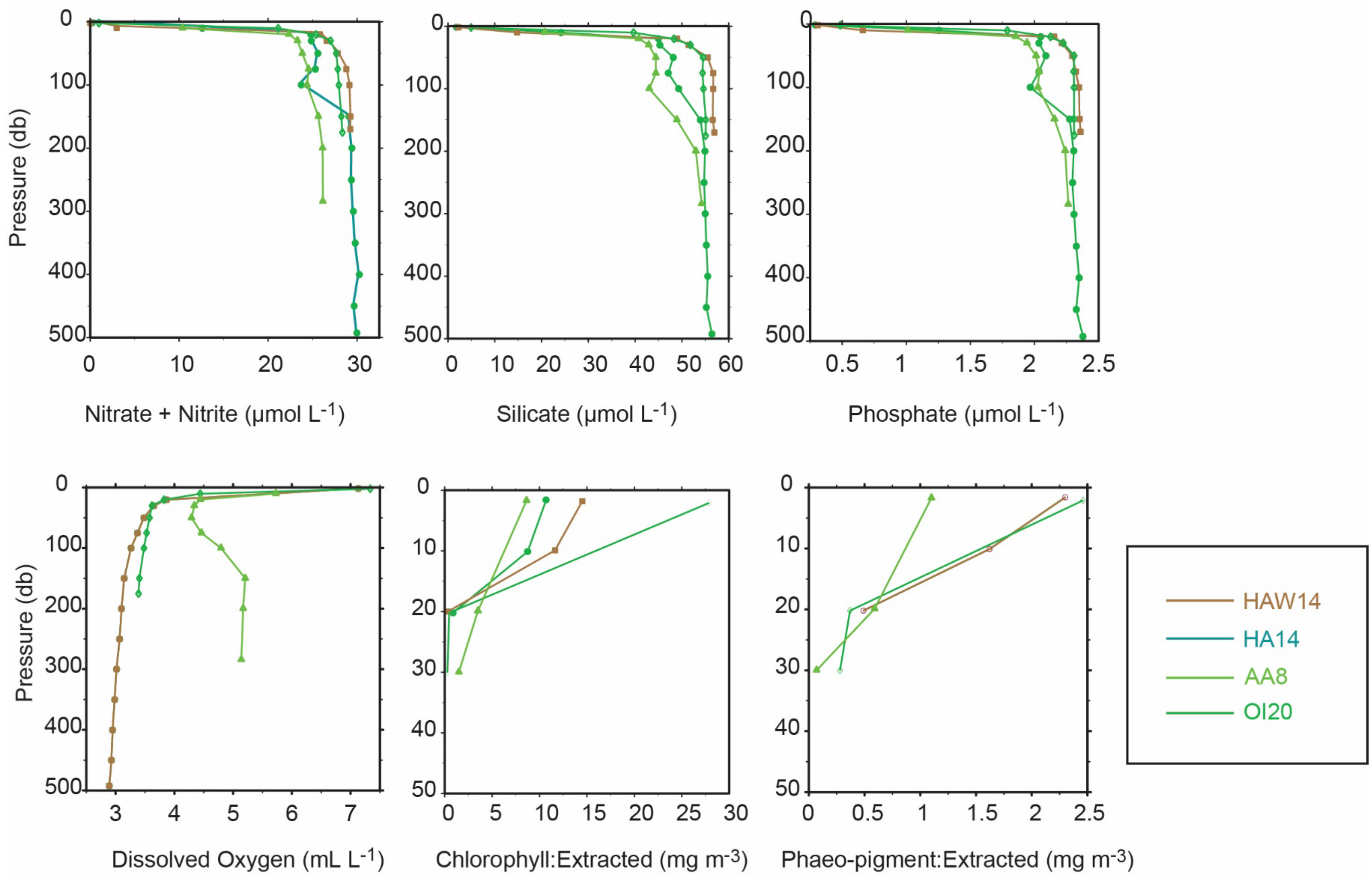

Figure 28. Niskin bottle data collected during 2018-025, Observatory Inlet Region.

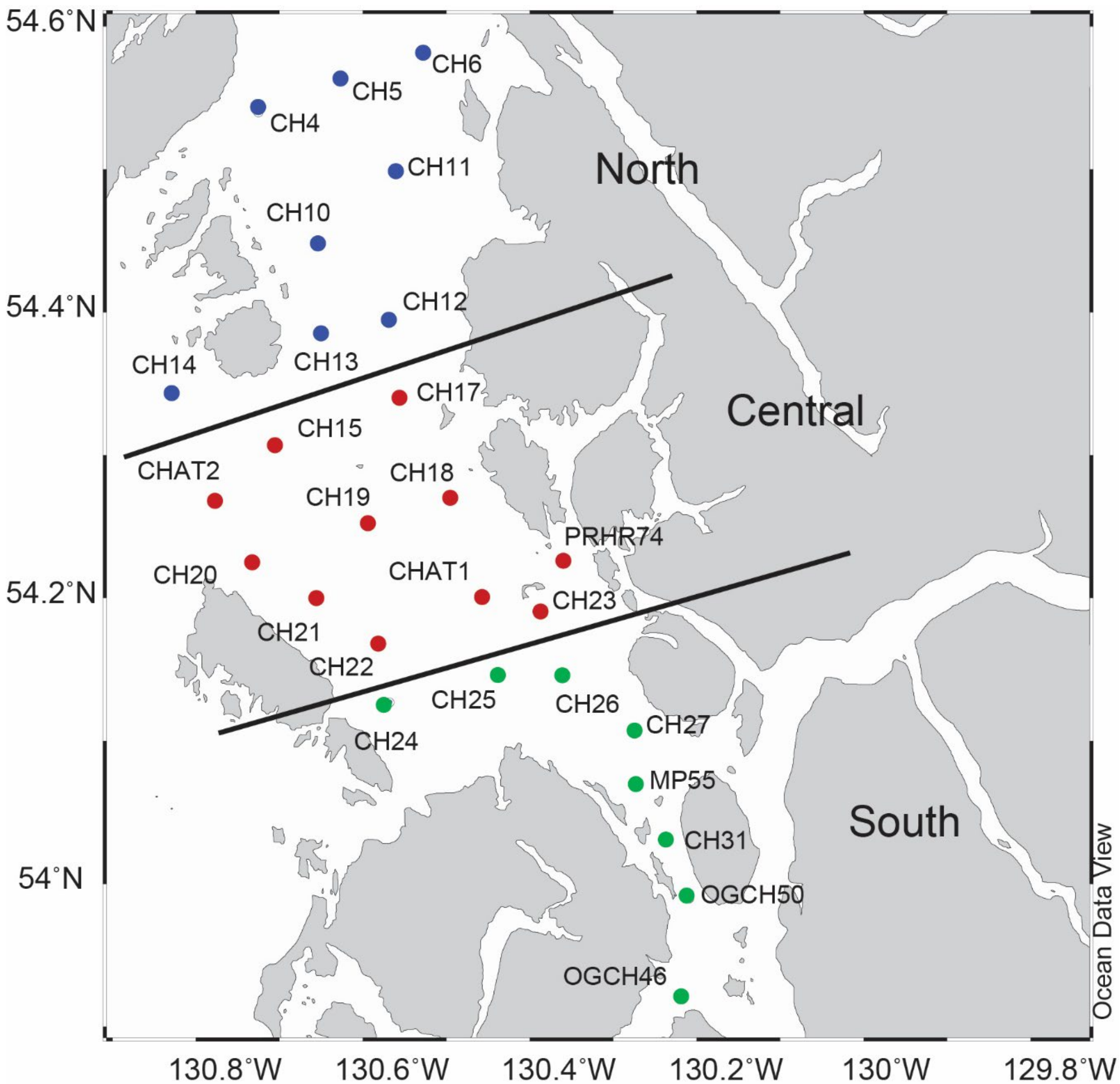

Figure 29. Chatham Sound Region station map, 2019-001.

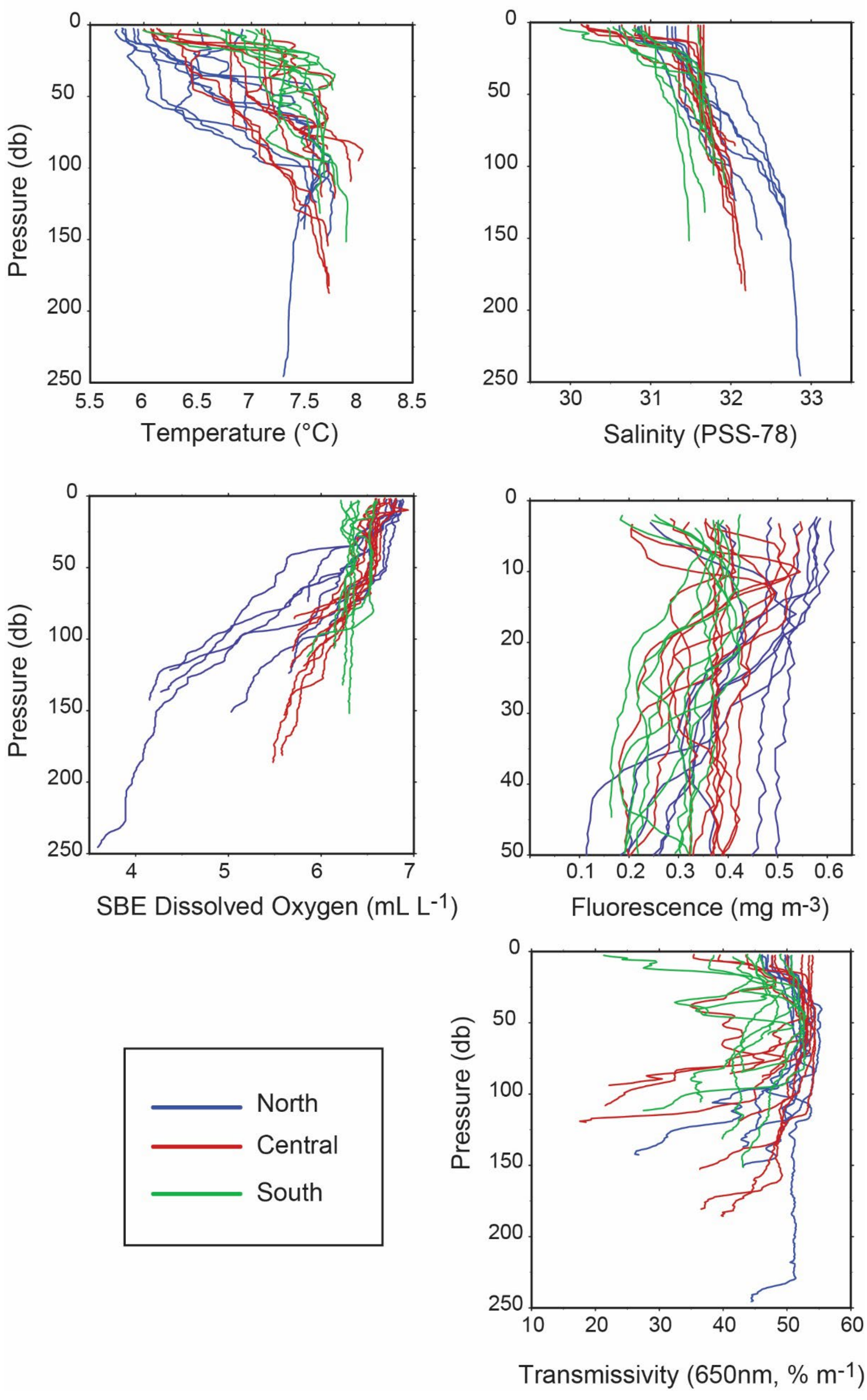

Figure 30. SBE911 data collected during 2019-001, Chatham Sound Region.

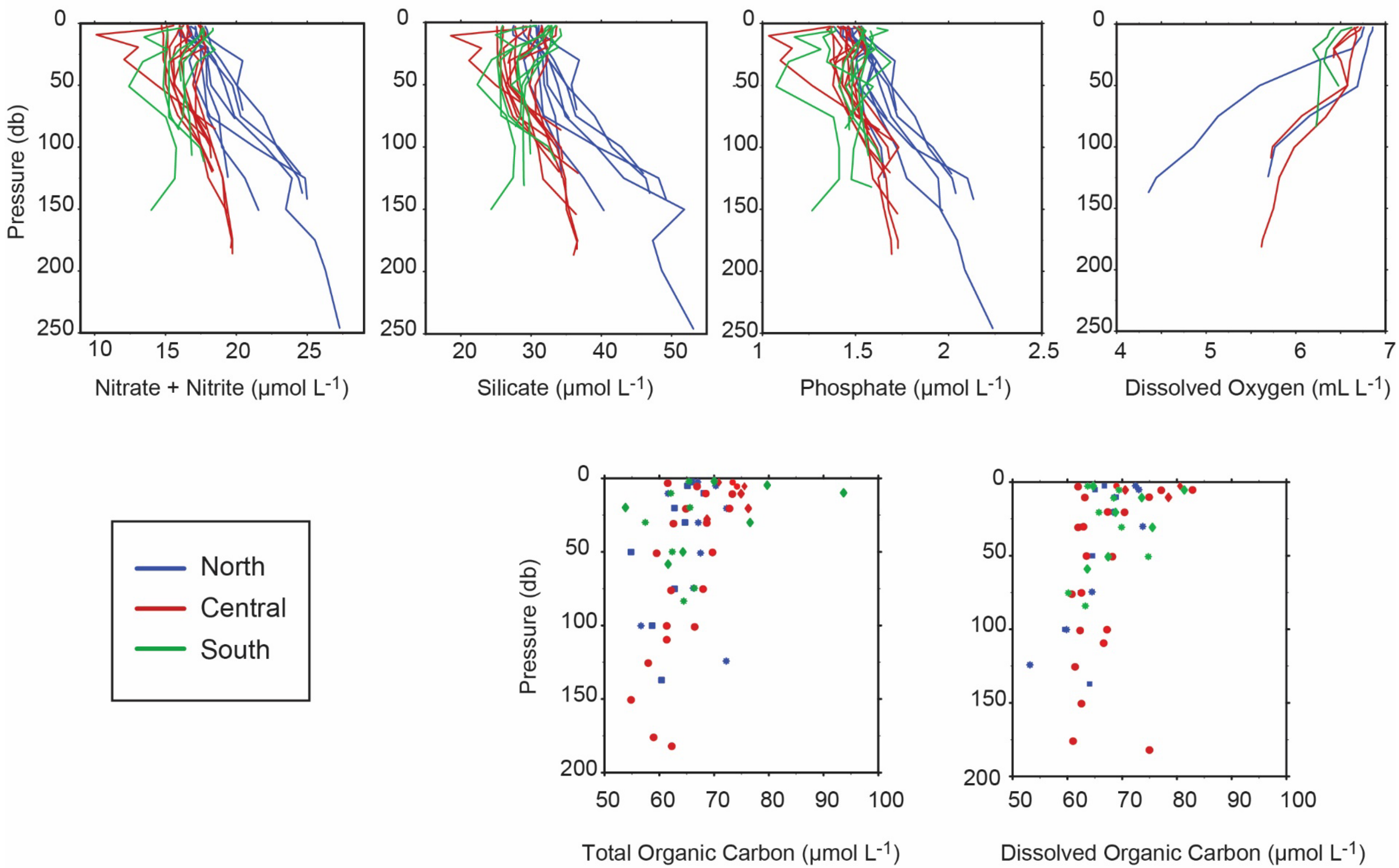

Figure 31. Niskin bottle data collected during 2019-001, Chatham Sound Region.

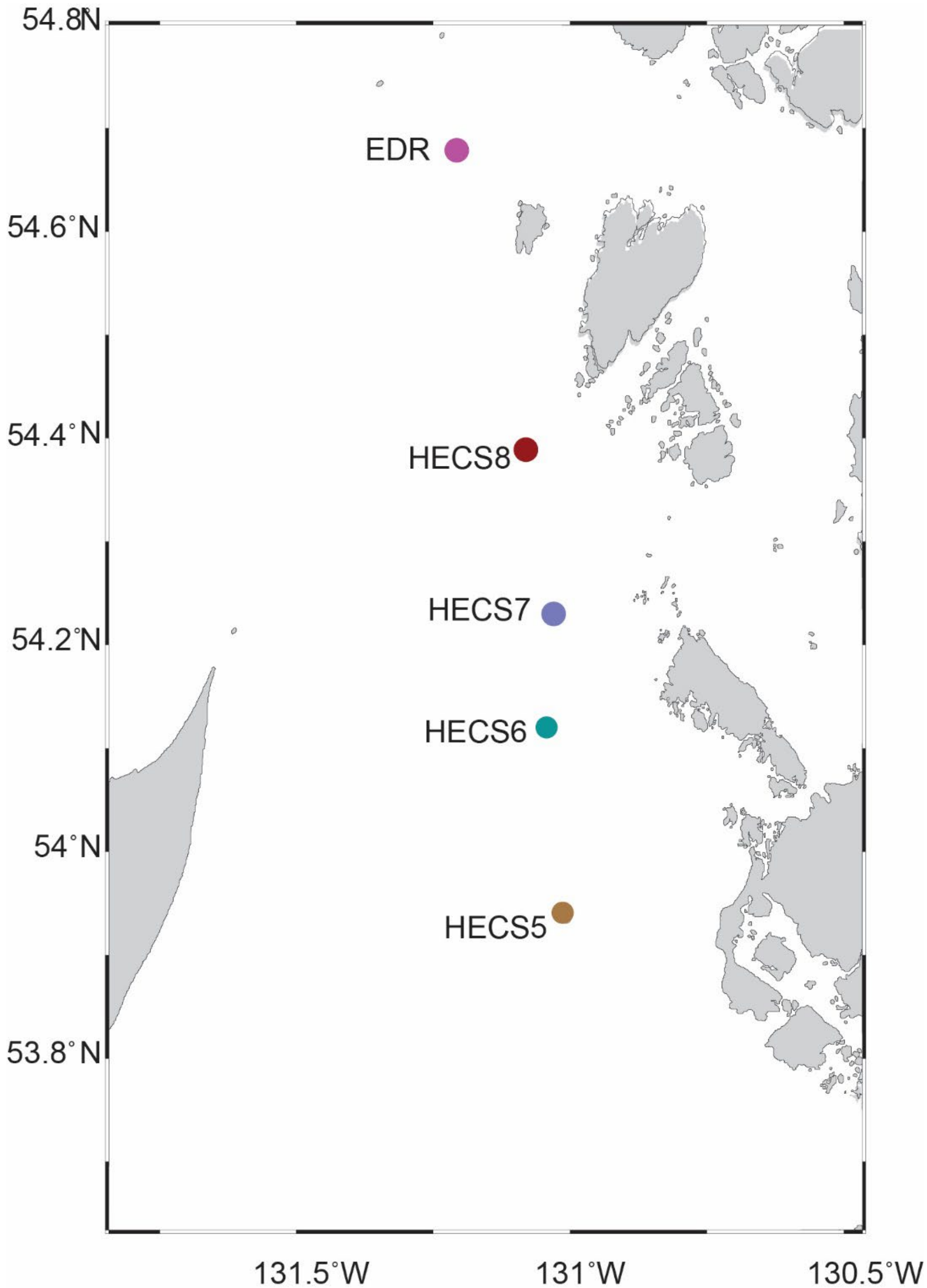

Figure 32. Hecate Strait Region station map, 2019-001.

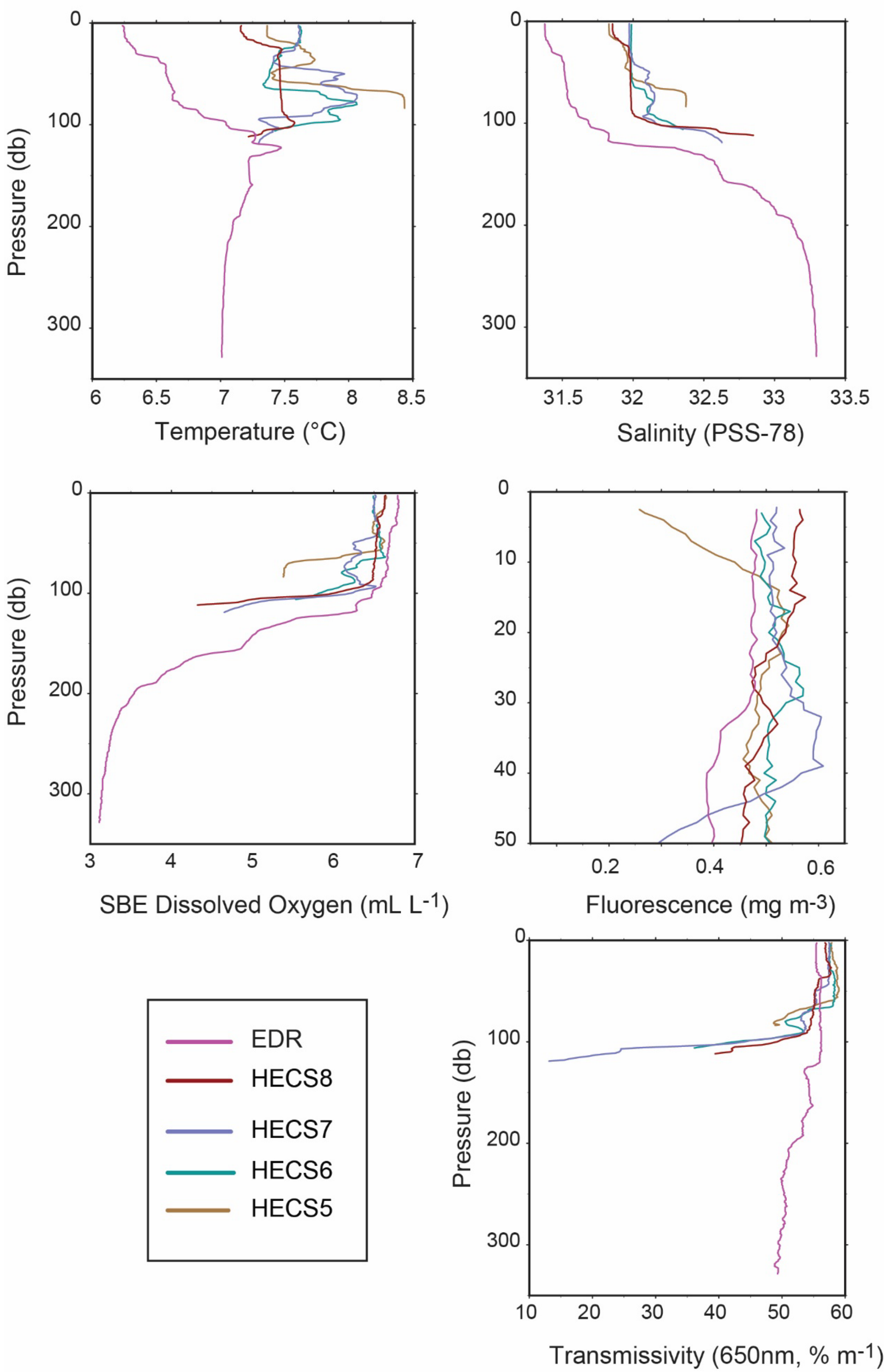

Figure 33. SBE911 data collected during 2019-001, Hecate Strait Region.

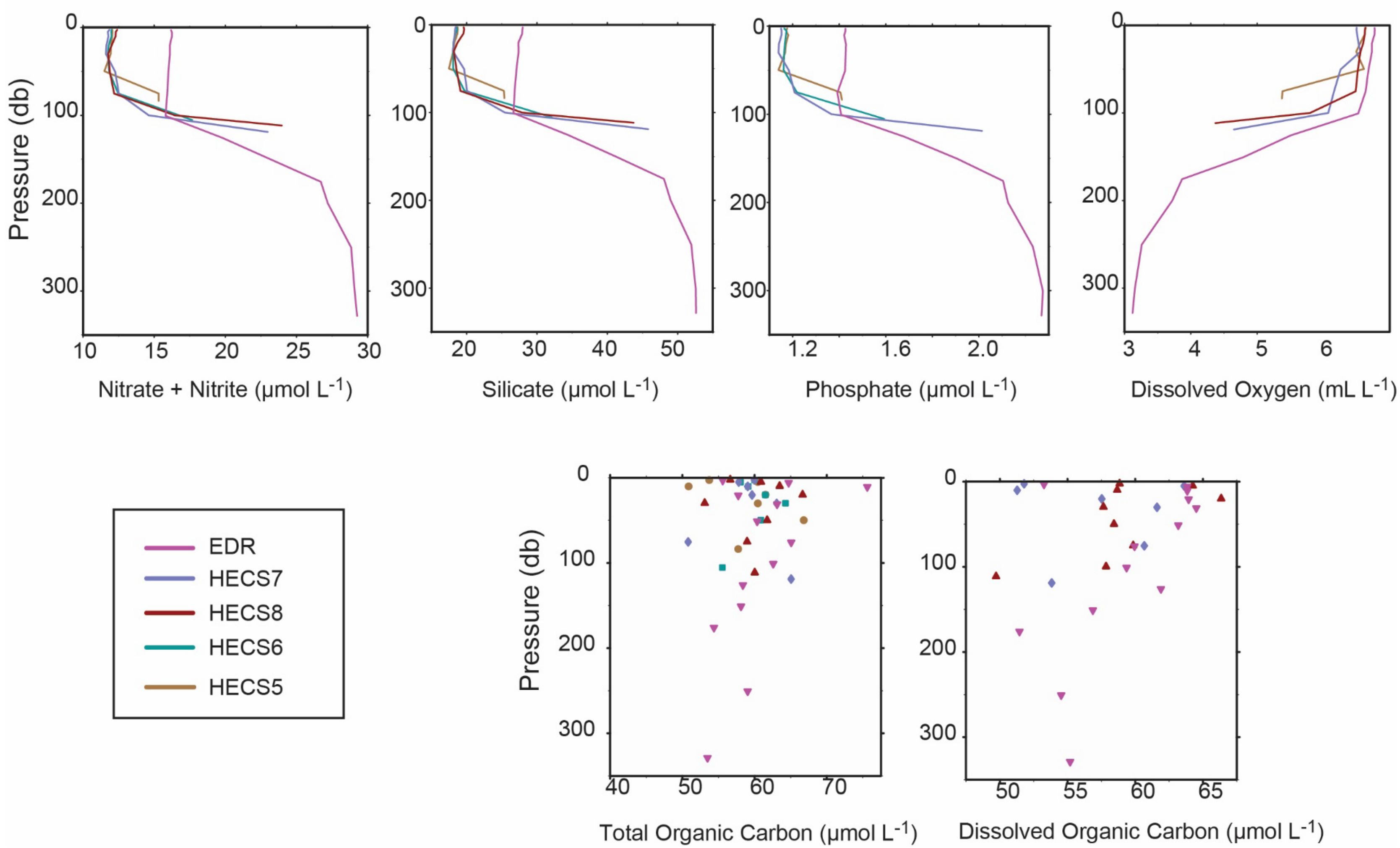

Figure 34. Niskin bottle data collected during 2019-001, Hecate Strait Region.

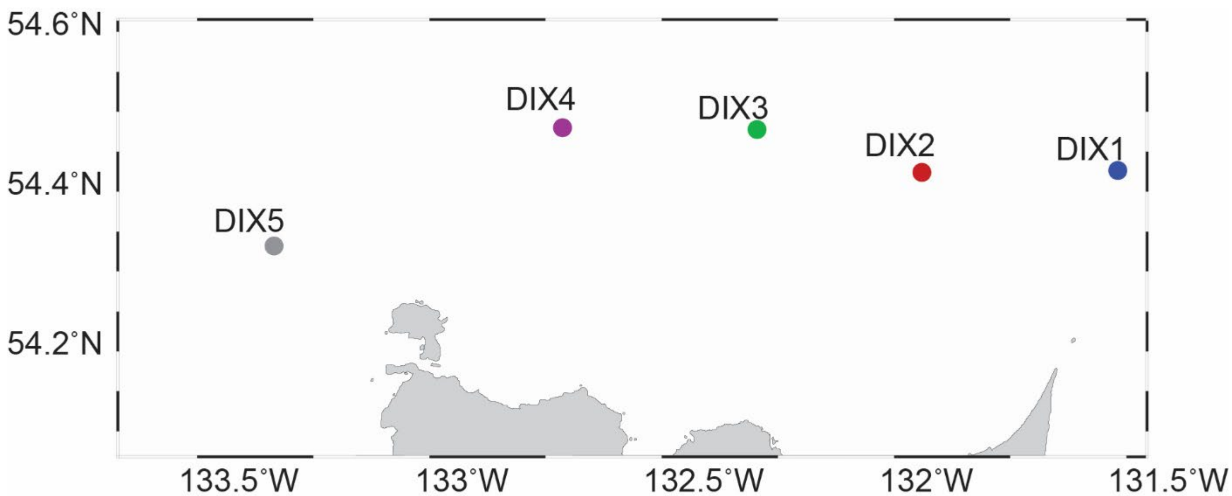

Figure 35. Dixon Entrance Region station map, 2019-001.

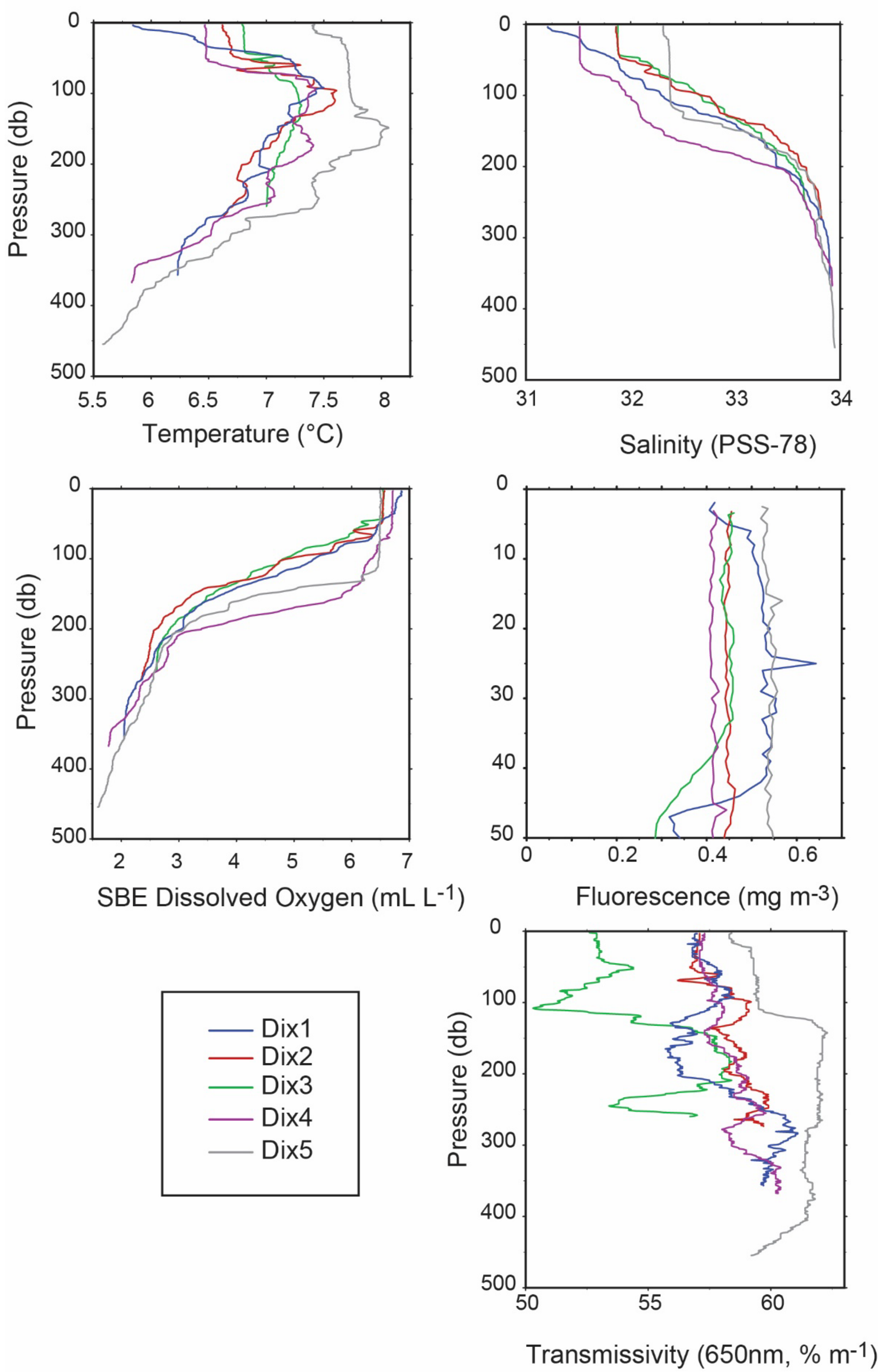

Figure 36. SBE911 data collected during 2019-001, Dixon Entrance Region.

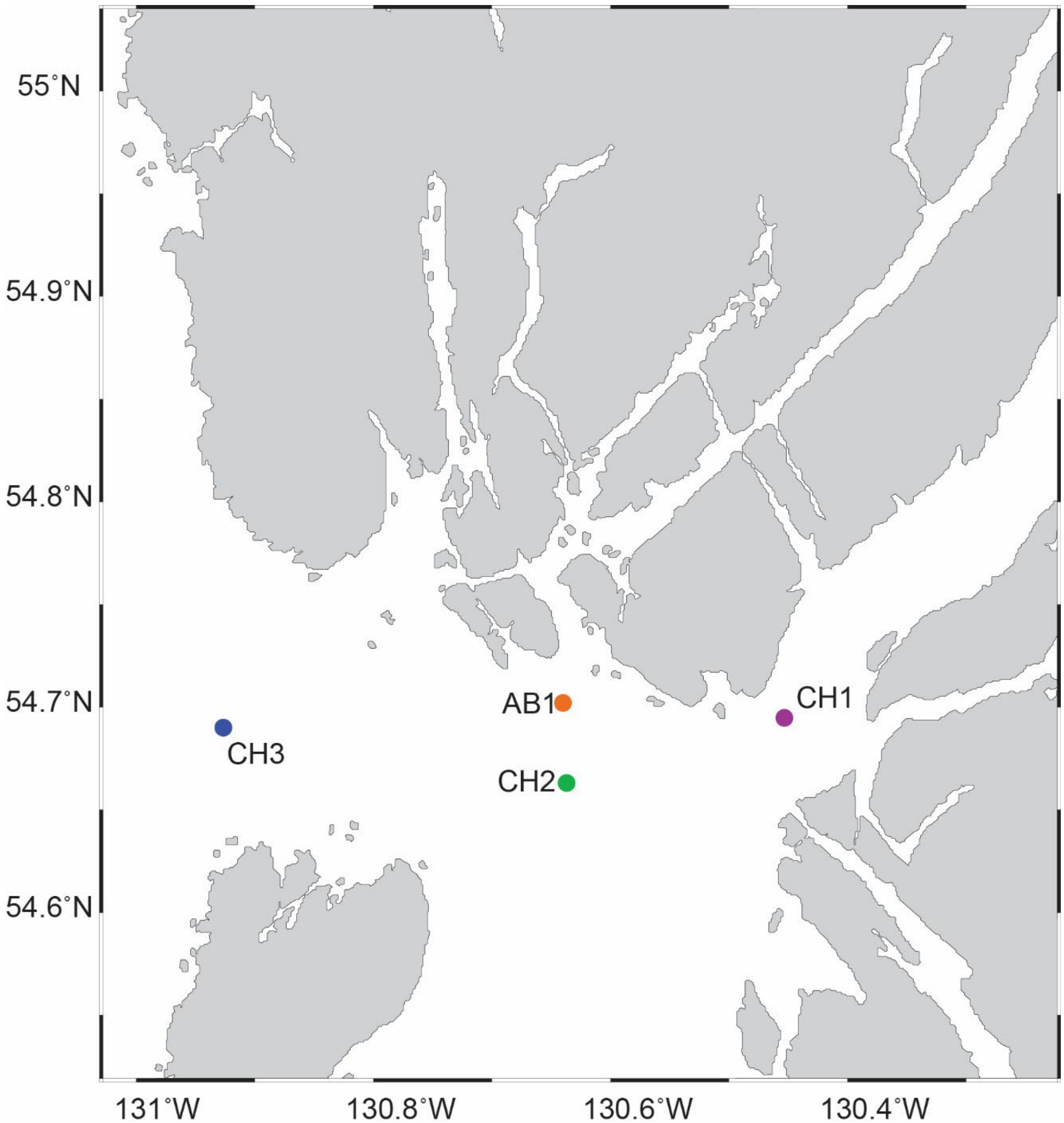

Figure 37. North Inlet Region station map, 2019-001.

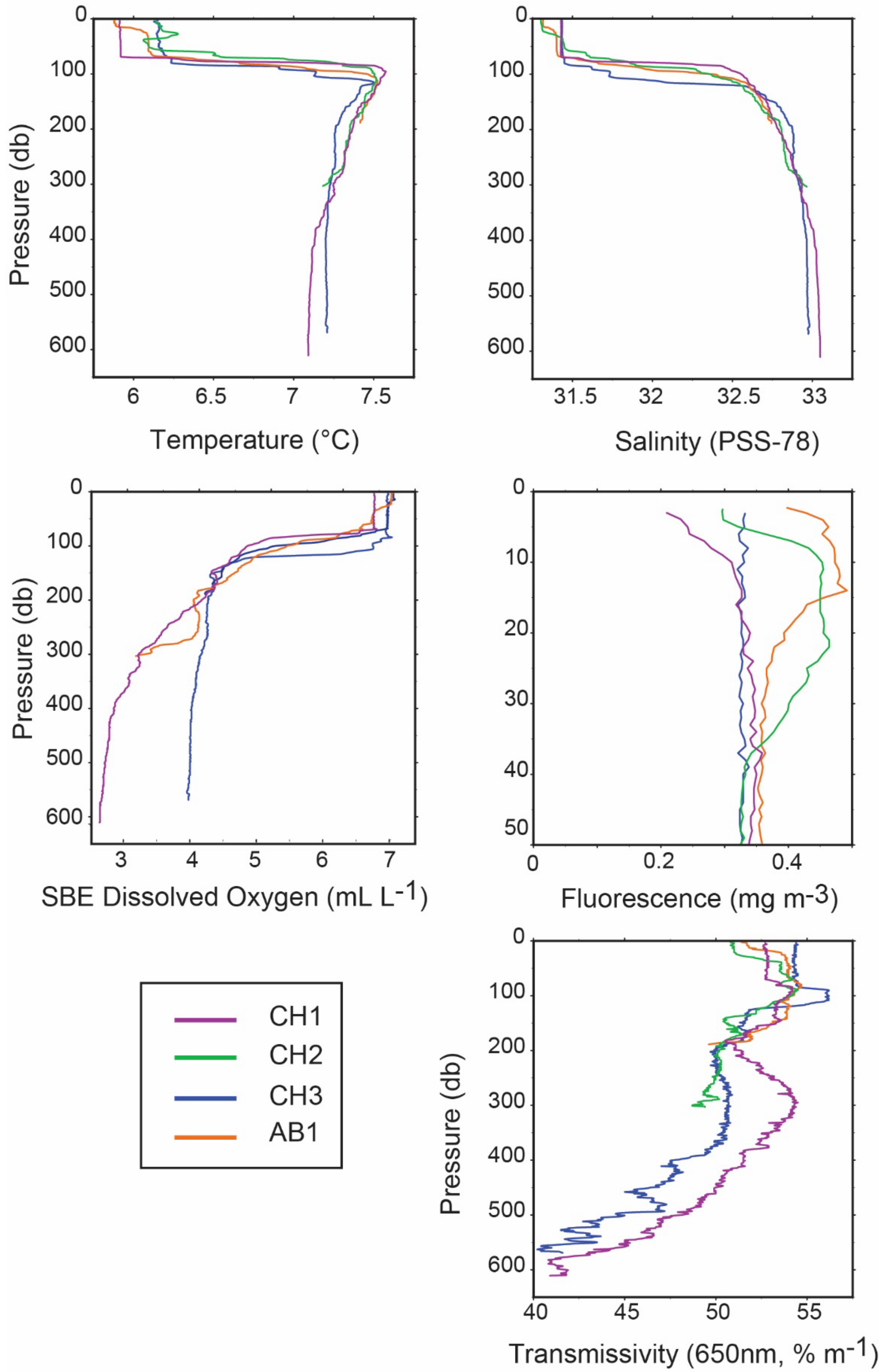

Figure 38. SBE911 data collected during 2019-001, North Inlet Region.

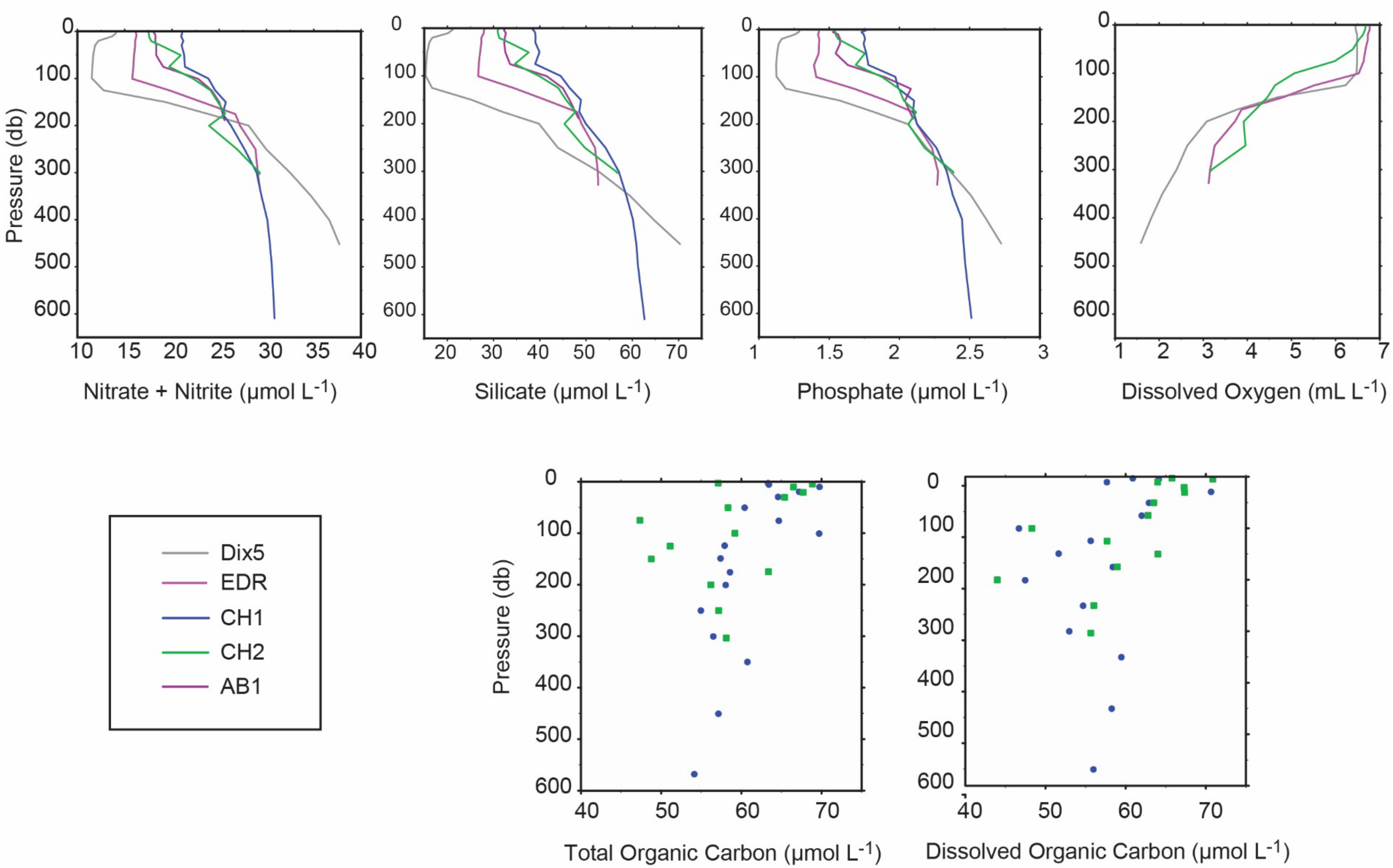

Figure 39. Niskin bottle data collected during 2019-001, Dixon Entrance and North Inlet Regions.

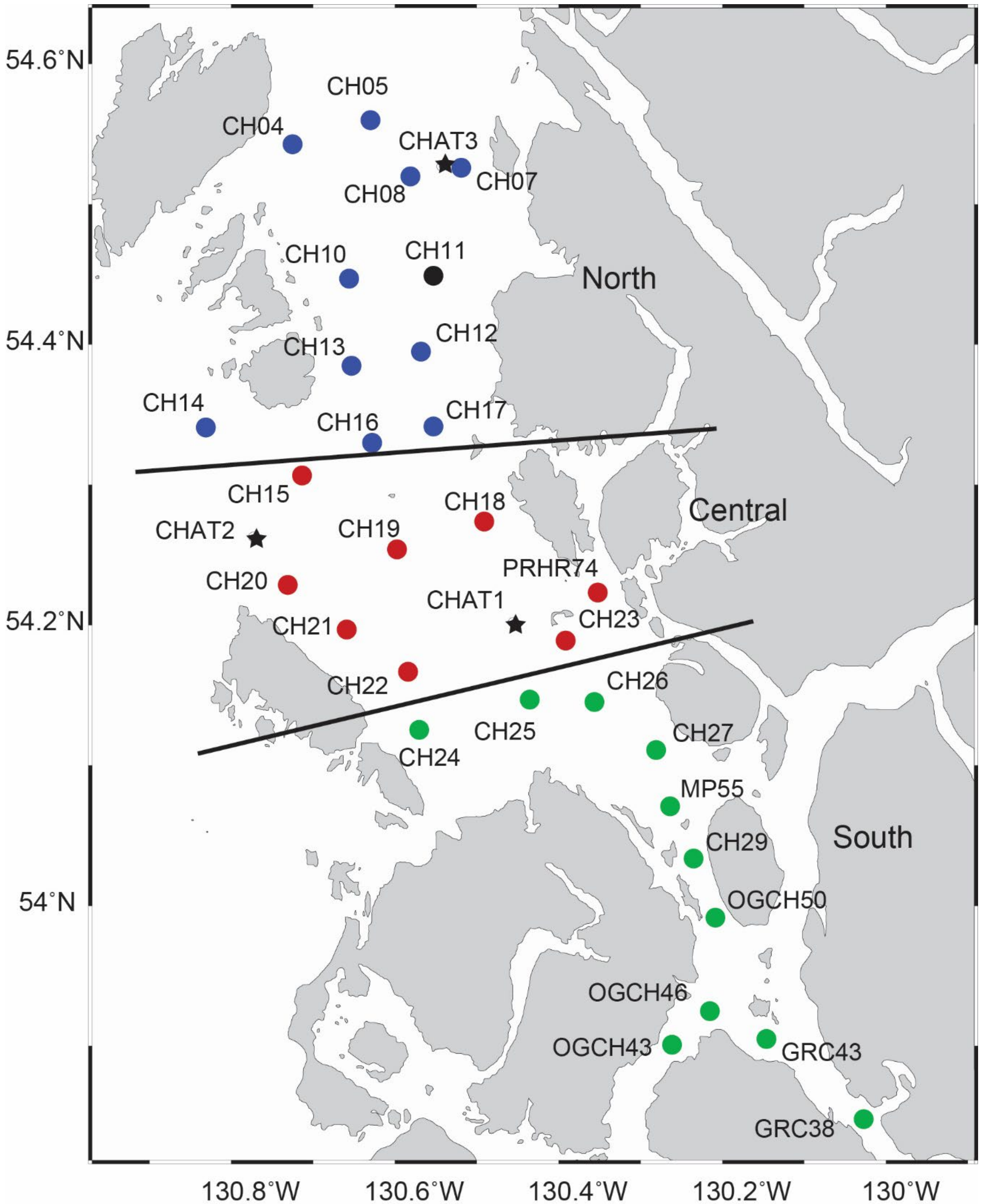

Figure 40. Chatham Sound Station Map, 2019-069. Stars represent mooring locations.

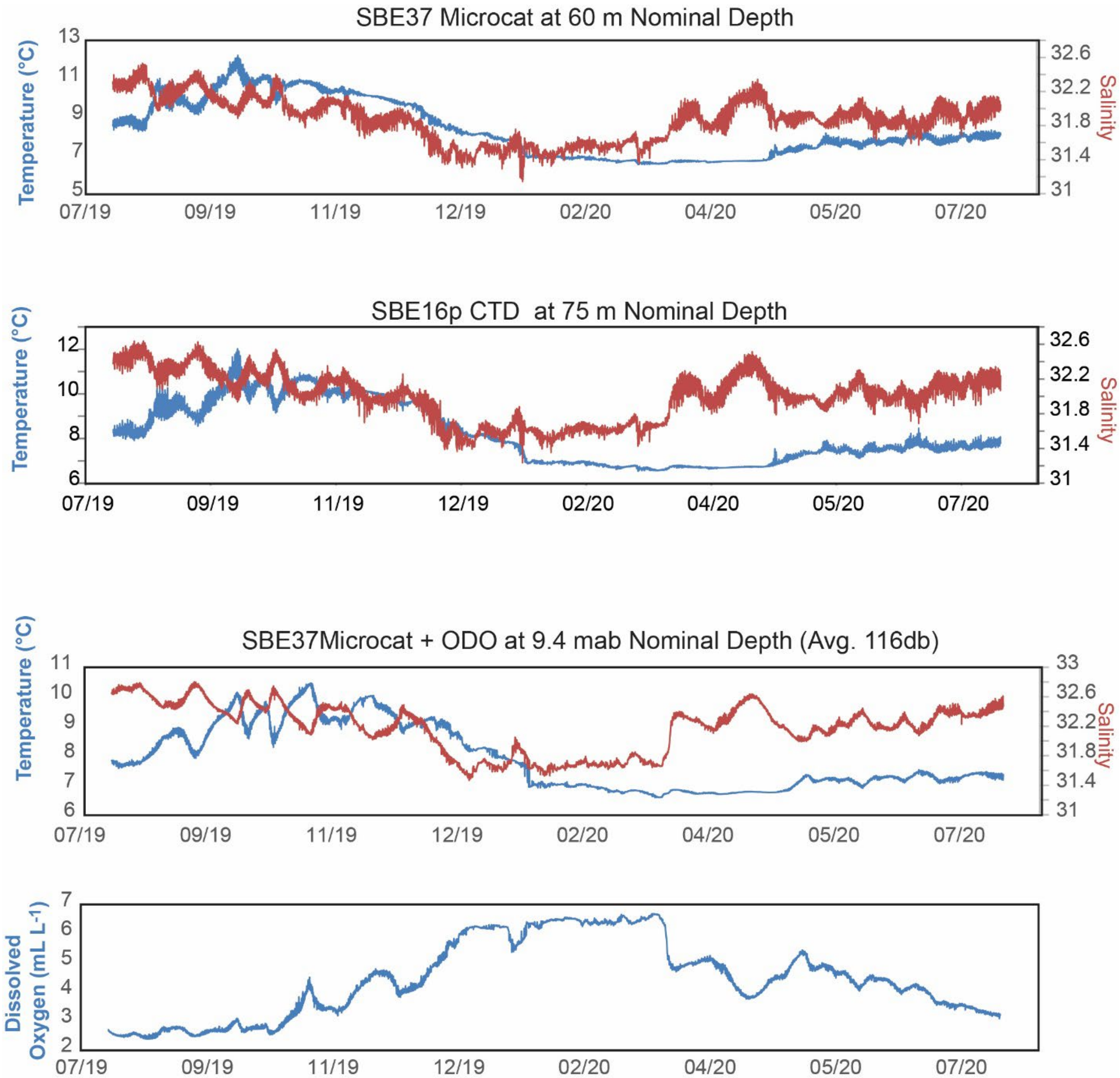

Figure 41. Time series for instruments collected at Chat1-2, 2019-2020. FLNTU data not shown due to sensor failure.

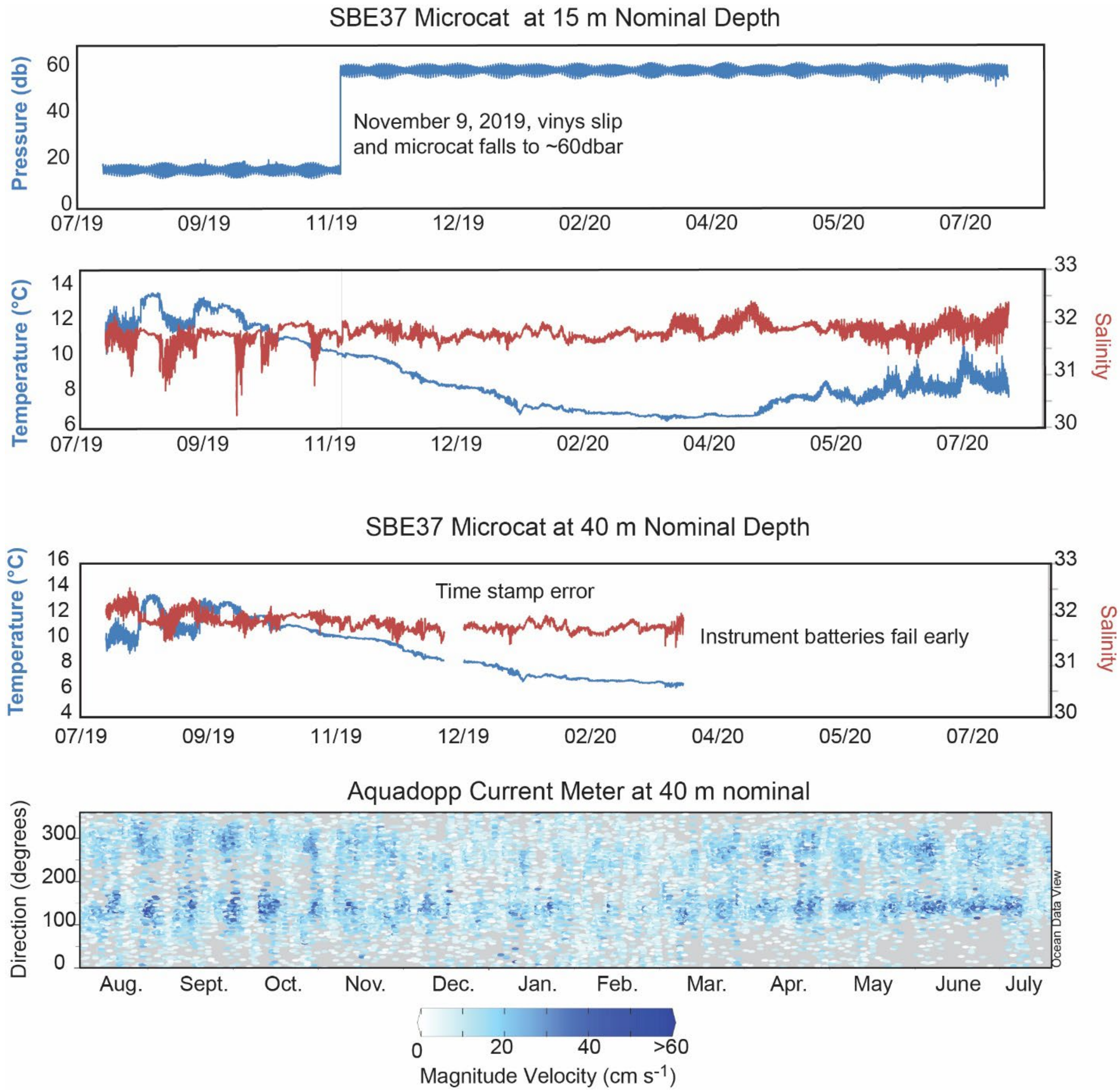

Figure 42. Time series for instrumentation collected at Chat2-1, 2019-2020.

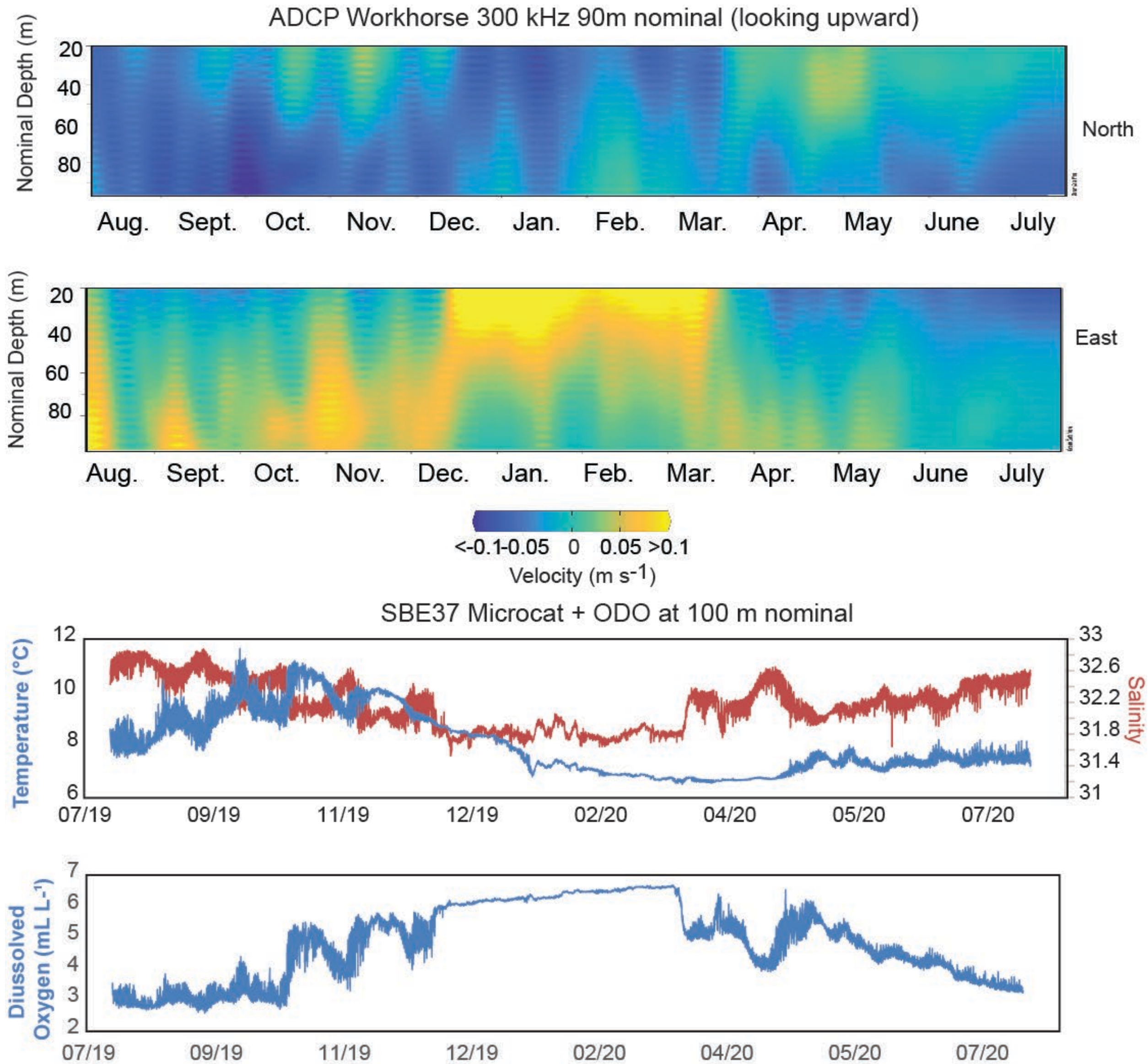

Figure 42 continued. Time series for instrumentation collected at Chat2-1, 2019-2020.

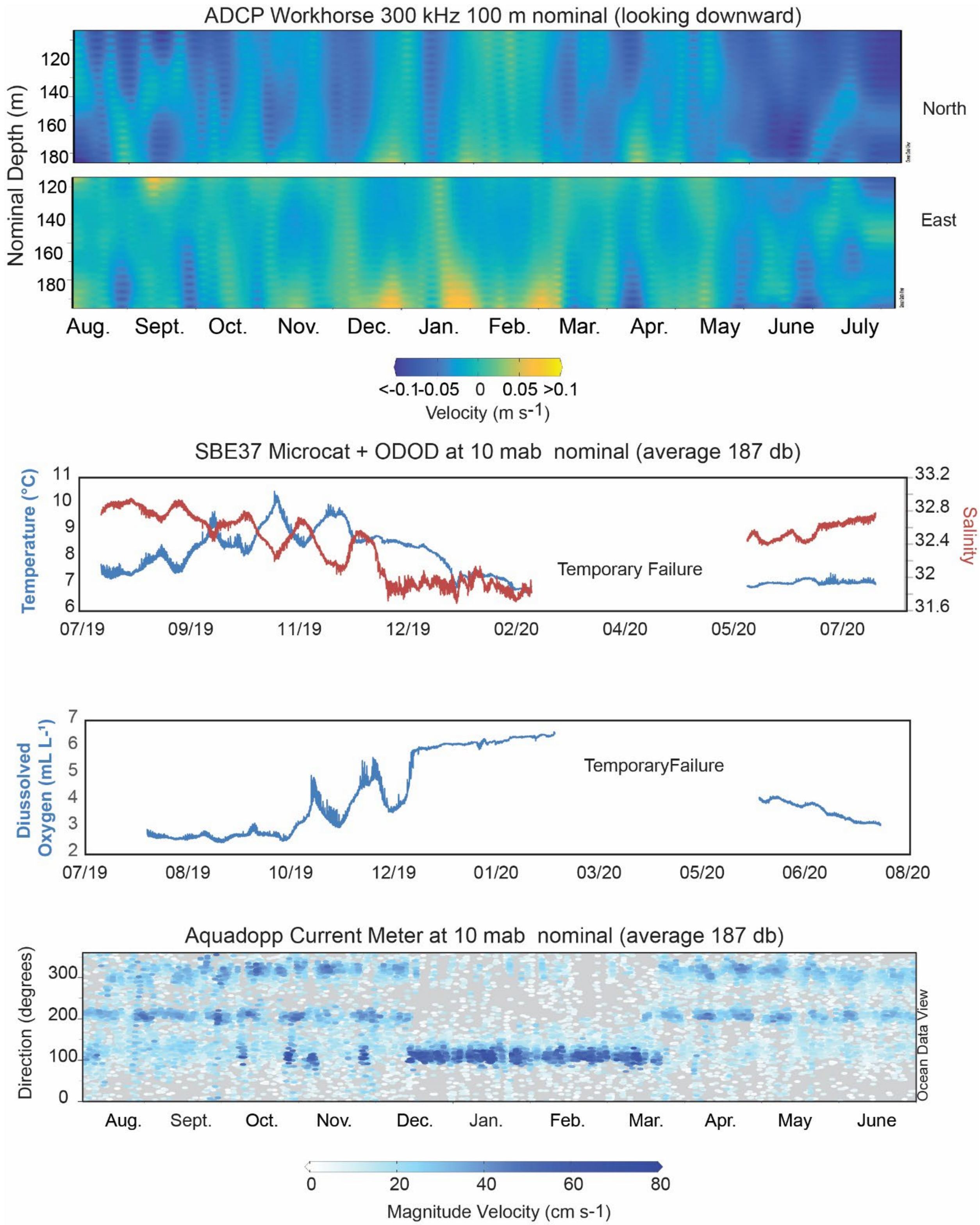

Figure 42 continued. Time series for instrumentation collected at Chat2-1, 2019-2020.

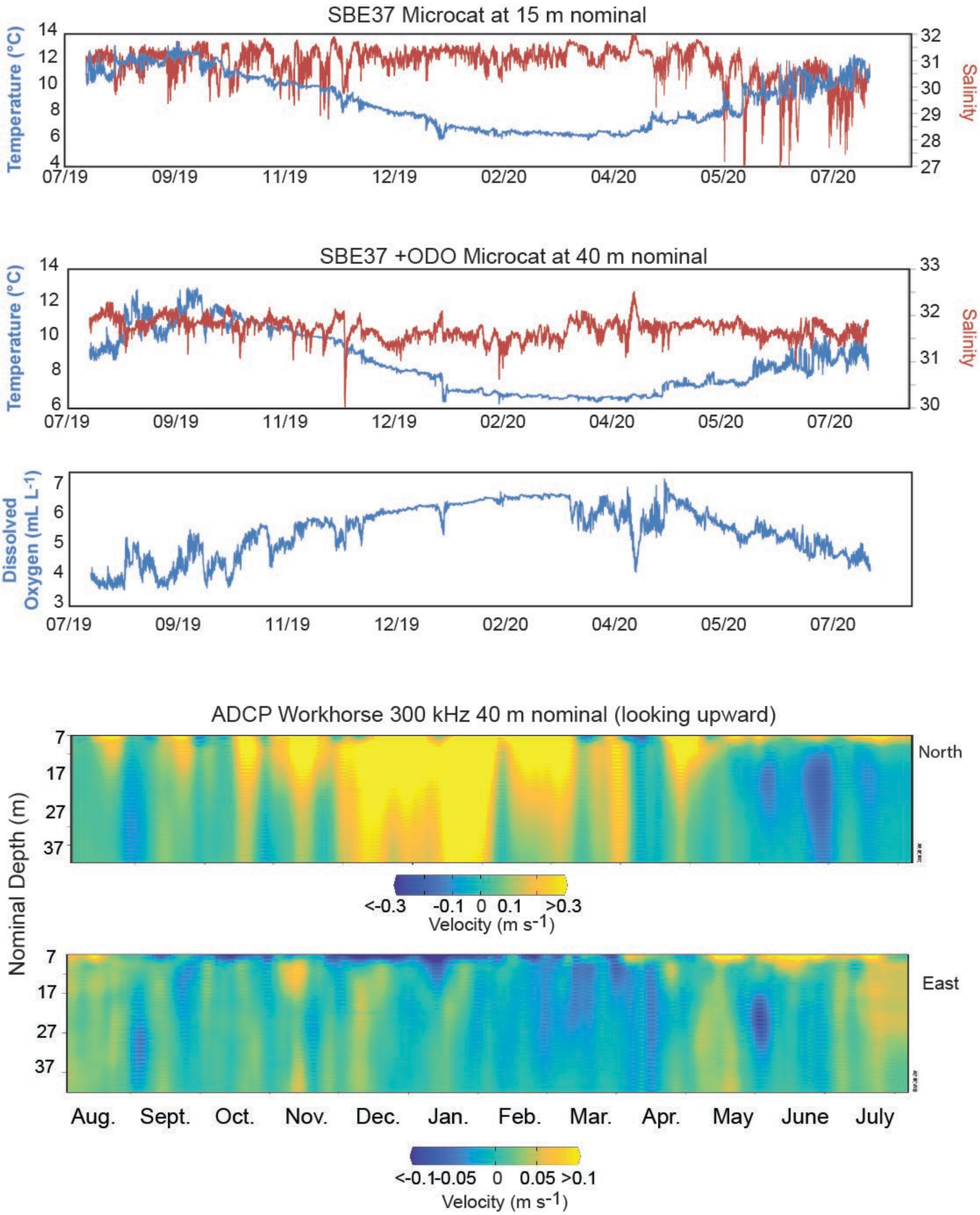

Figure 43. Time series for instrumentation collected at Chat3-1, 2019-2020.

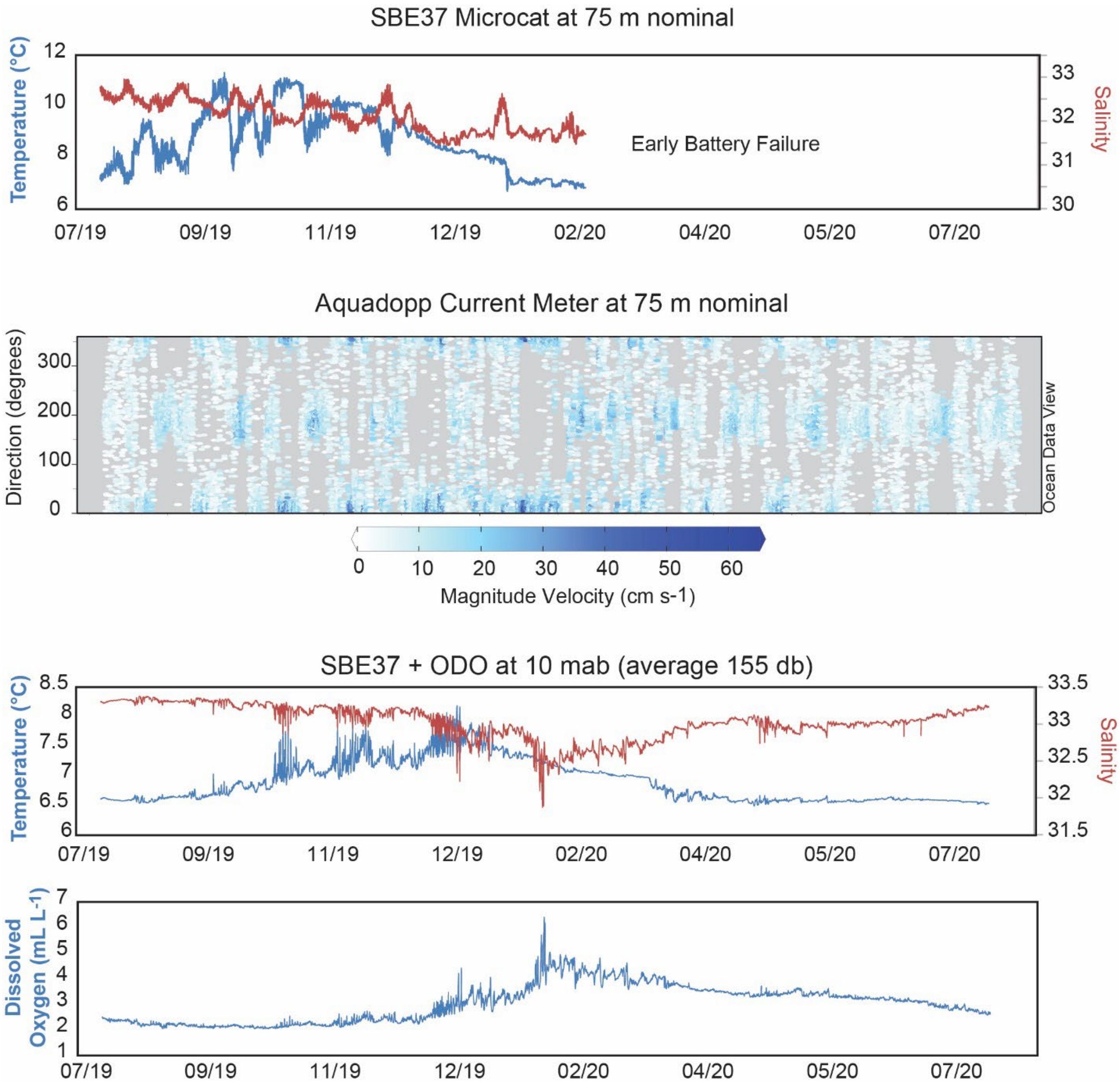

Figure 43 continued. Time series for instrumentation collected at Chat3-1, 2019-2020.

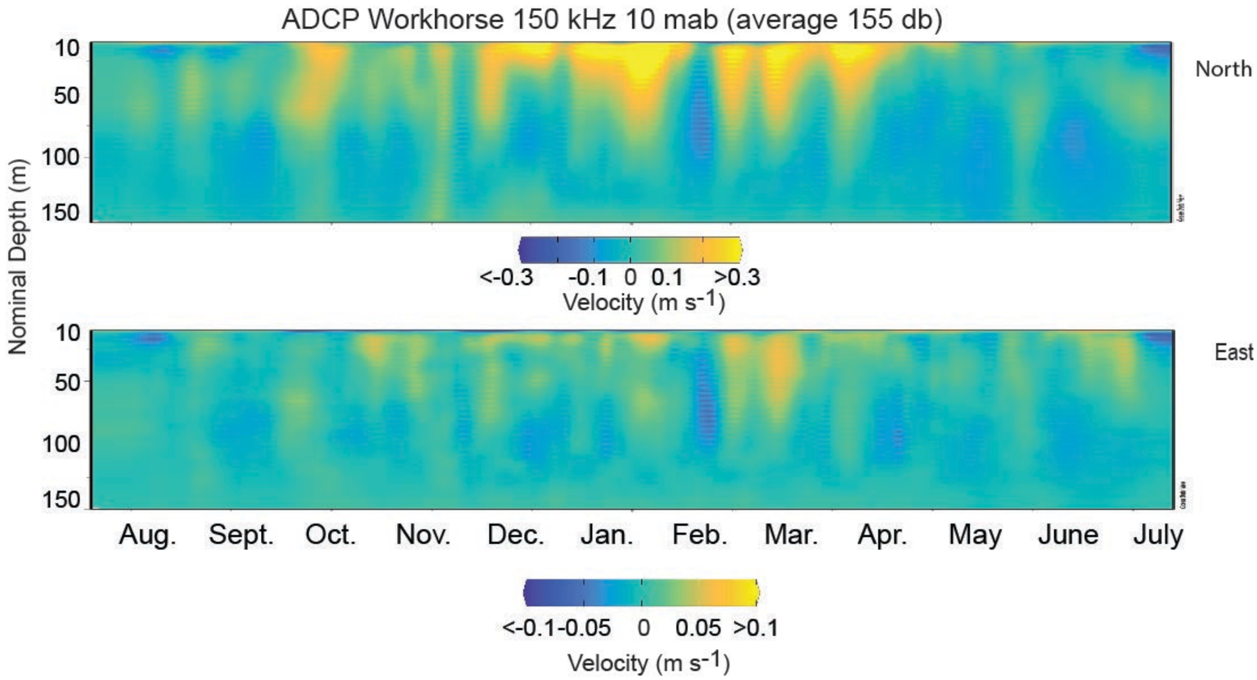

Figure 43 continued. Time series for instrumentation collected at Chat3-1, 2019-2020.

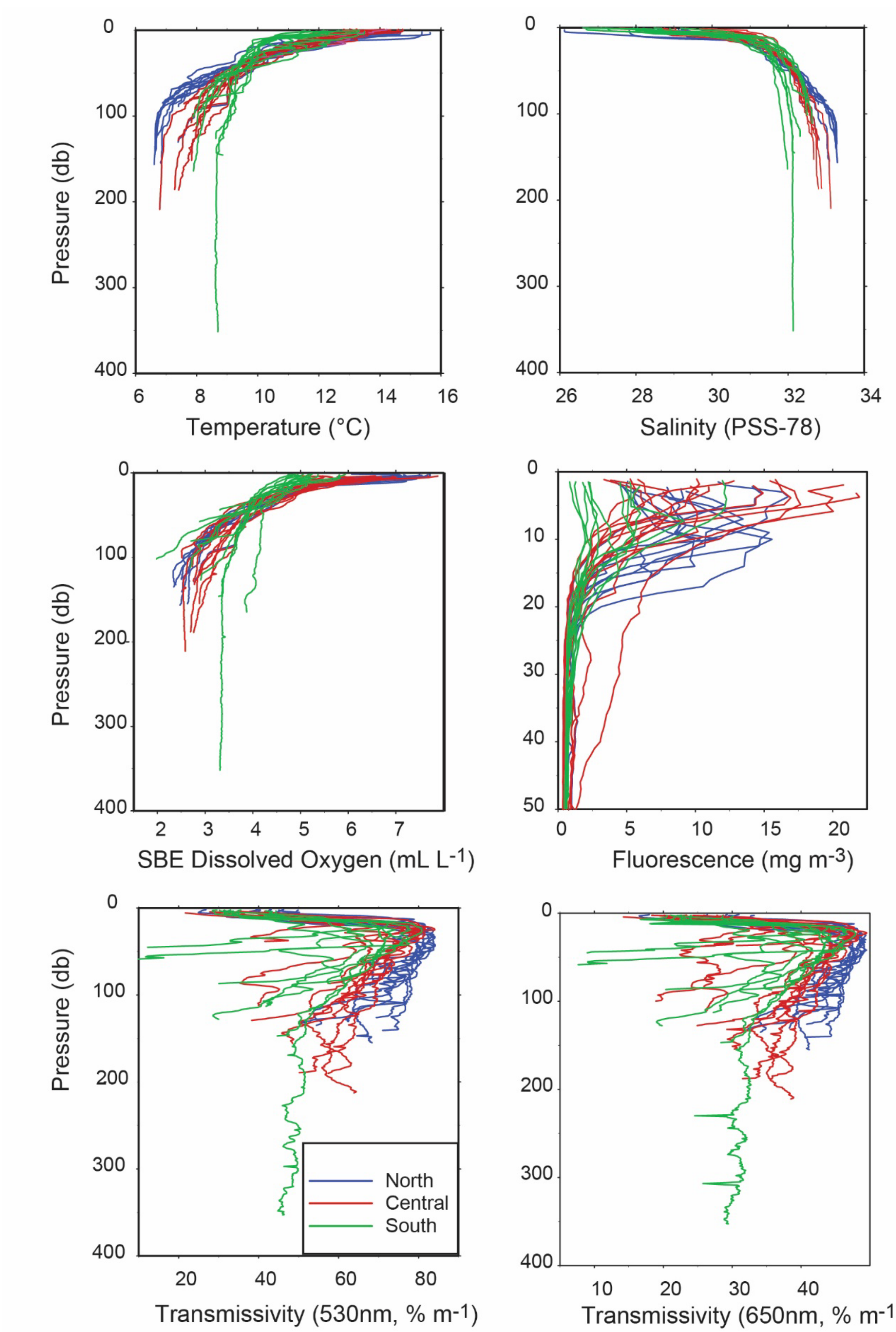

Figure 44. SBE911 data collected during 2019-069, Chatham Sound Region.

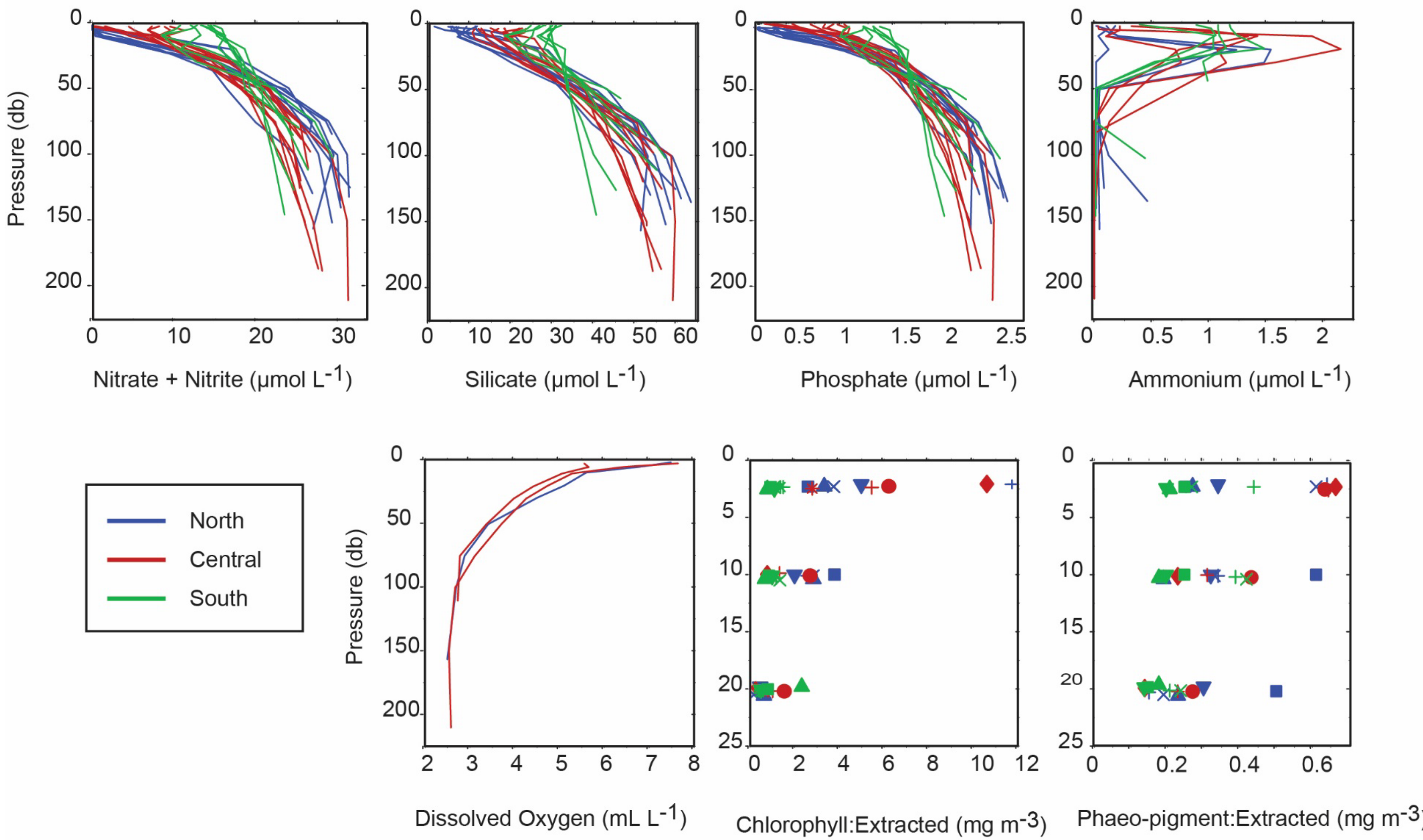

Figure 45. Niskin bottle data collected during 2019-069, Chatham Sound Region only.

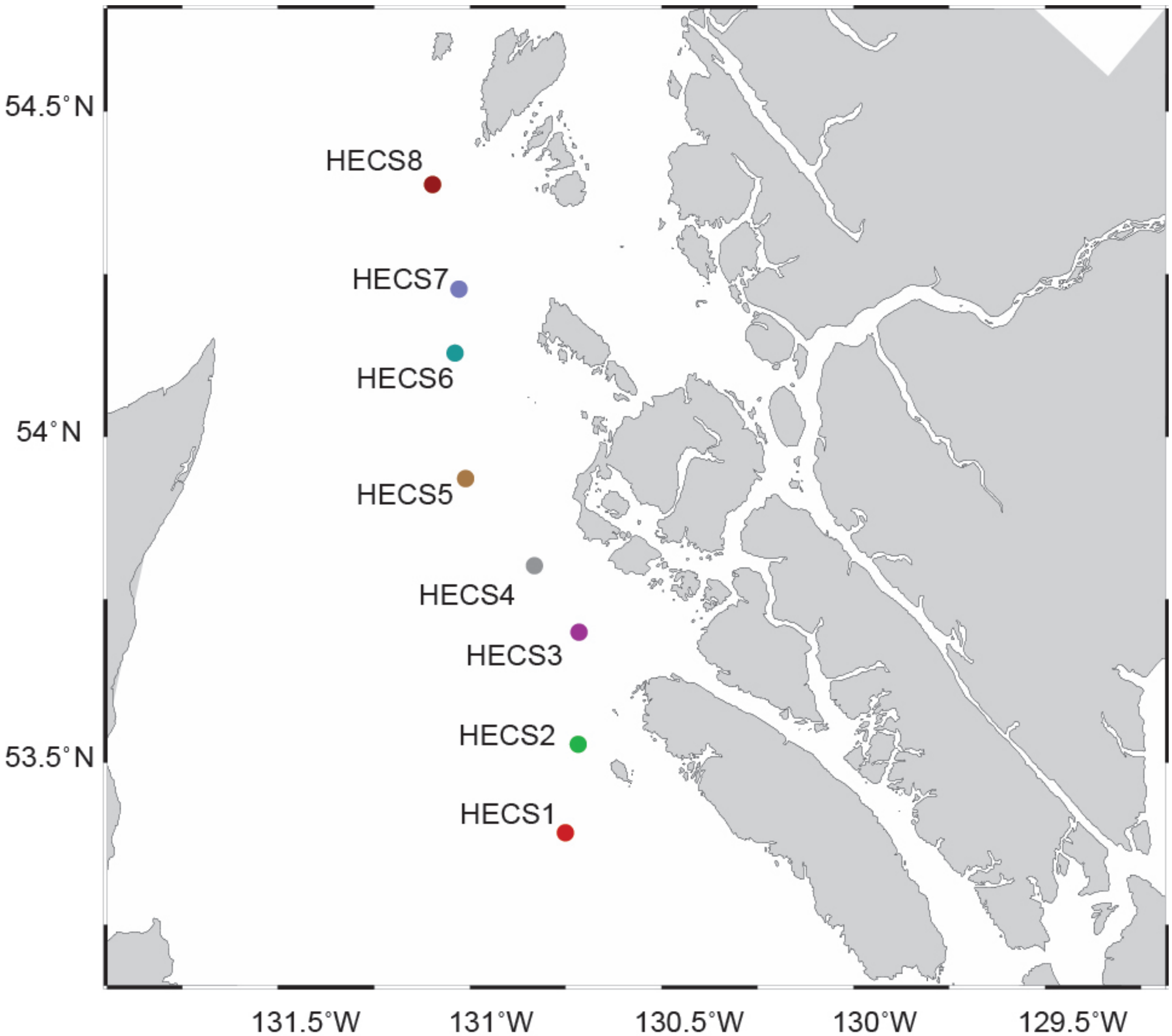

Figure 46. Hecate Strait Region station map, 2019-069.

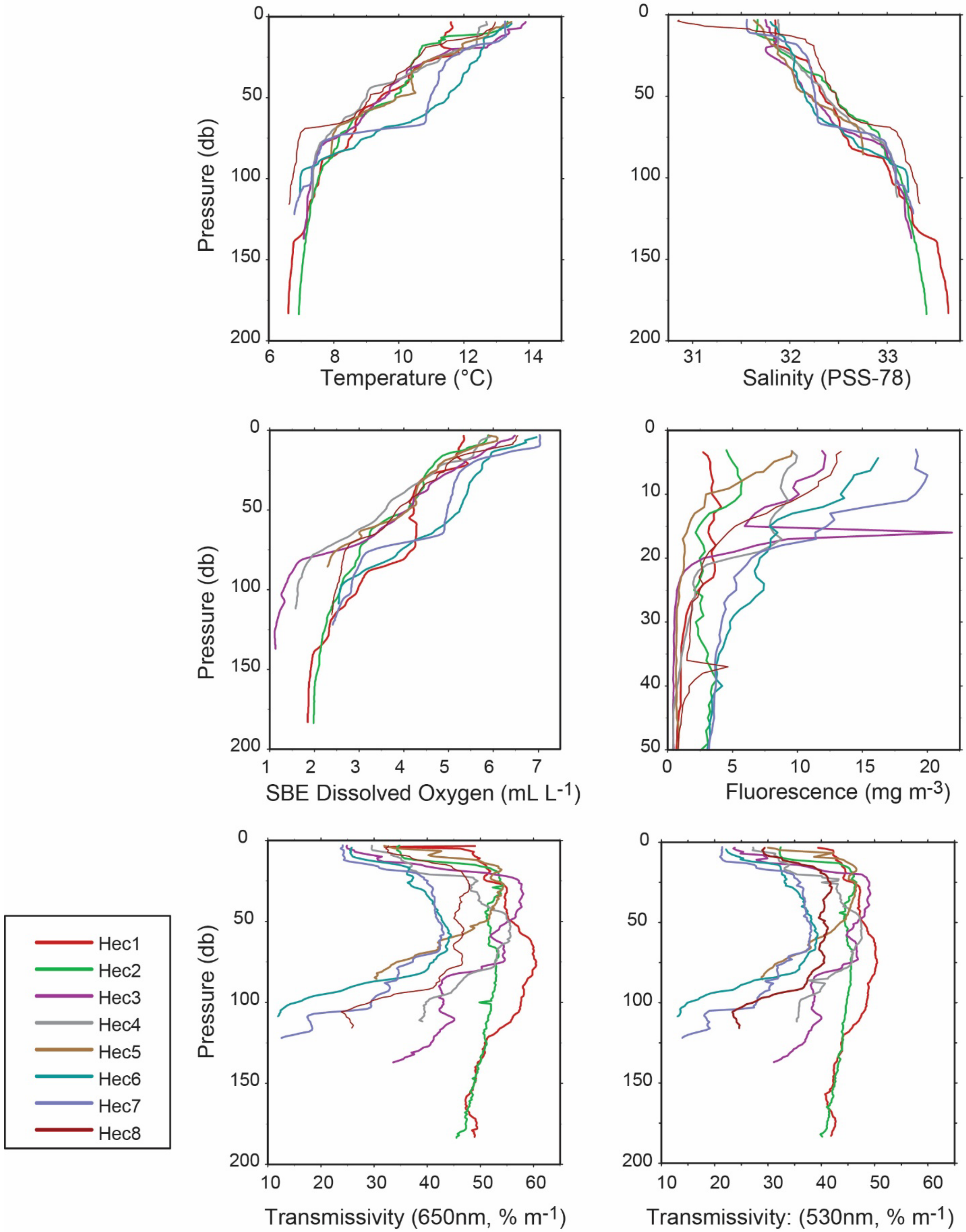

Figure 47. SBE 911 data collected during 2019-069, Hecate Strait Region.

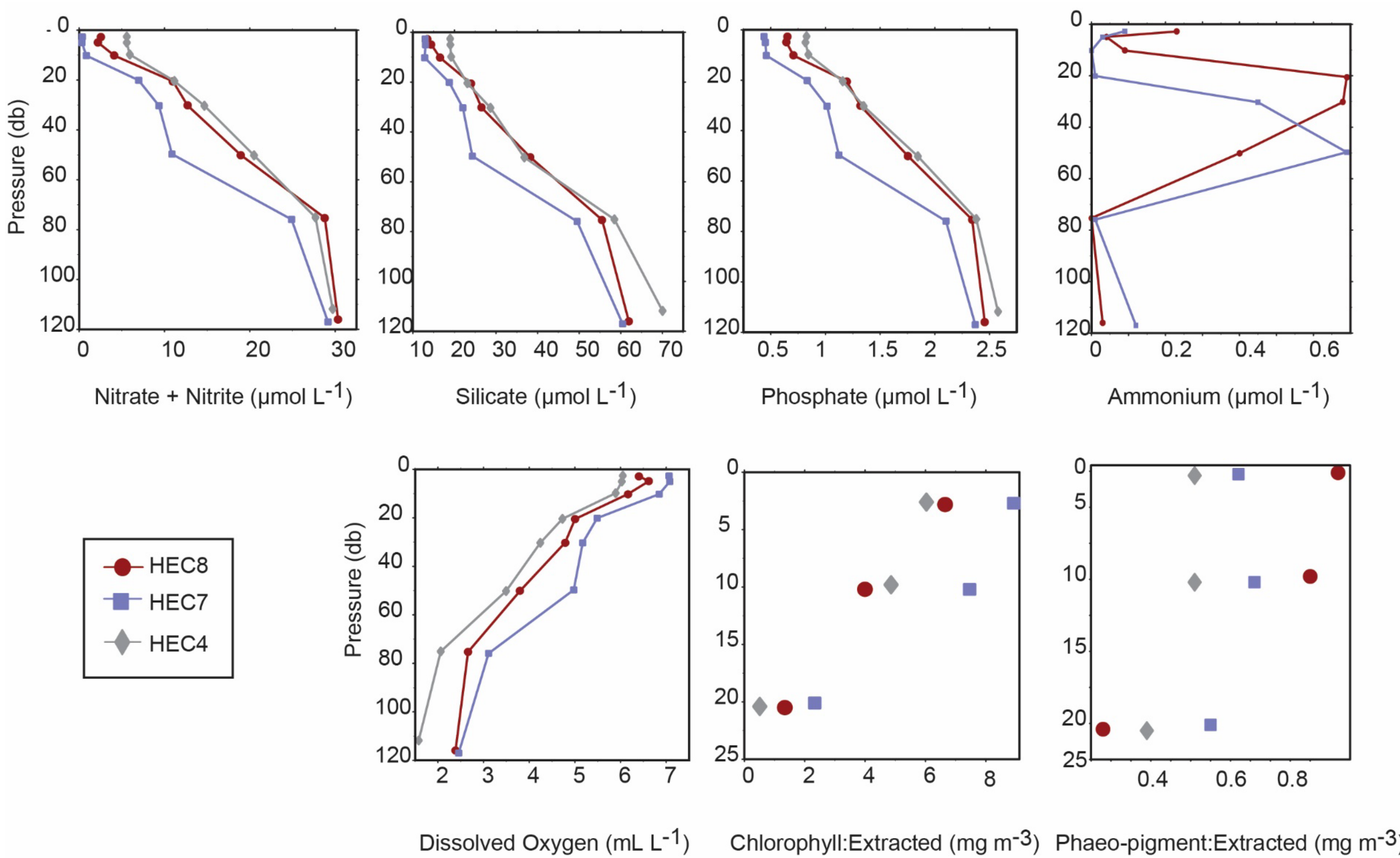

Figure 48. Niskin bottle data collected during 2019-069, Hecate Strait Region only.

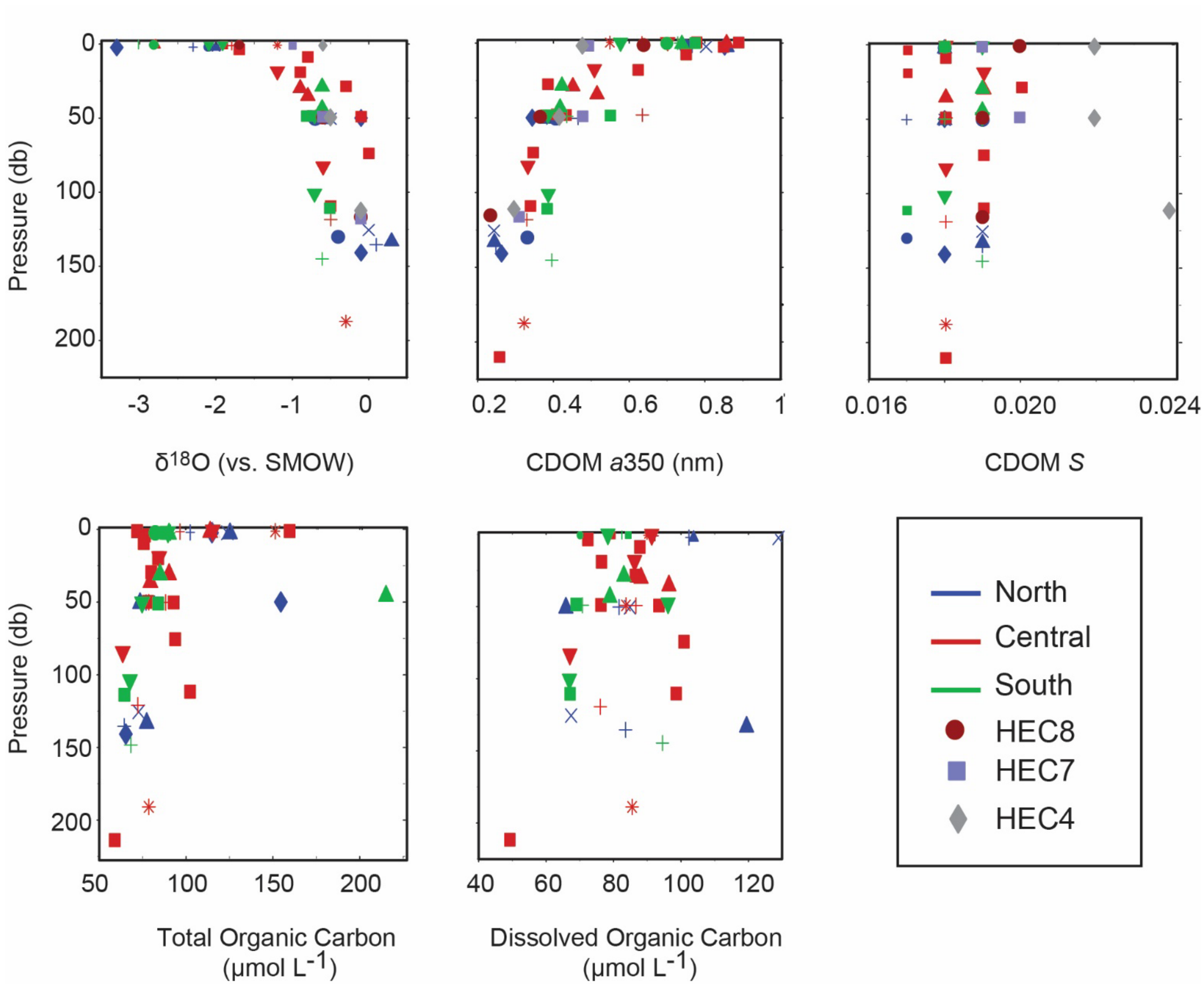

Figure 49. Niskin bottle data collected during 2019-069, combined Chatham Sound and Hecate Strait Regions.

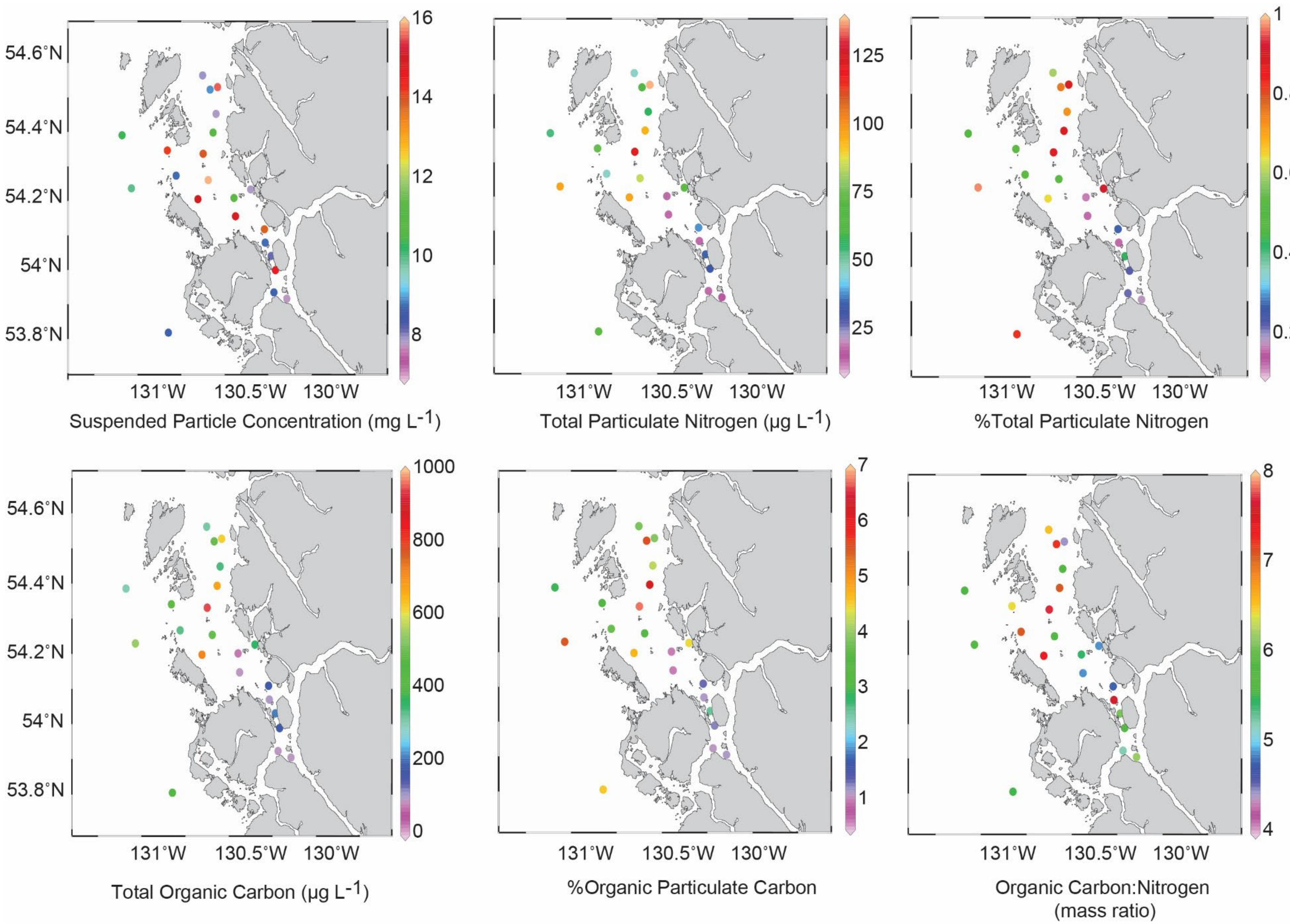

Figure 50. Results of the GFF suspended particulate matter analysis collected on 2019-069, Chatham Sound and Hecate Strait Regions combined.

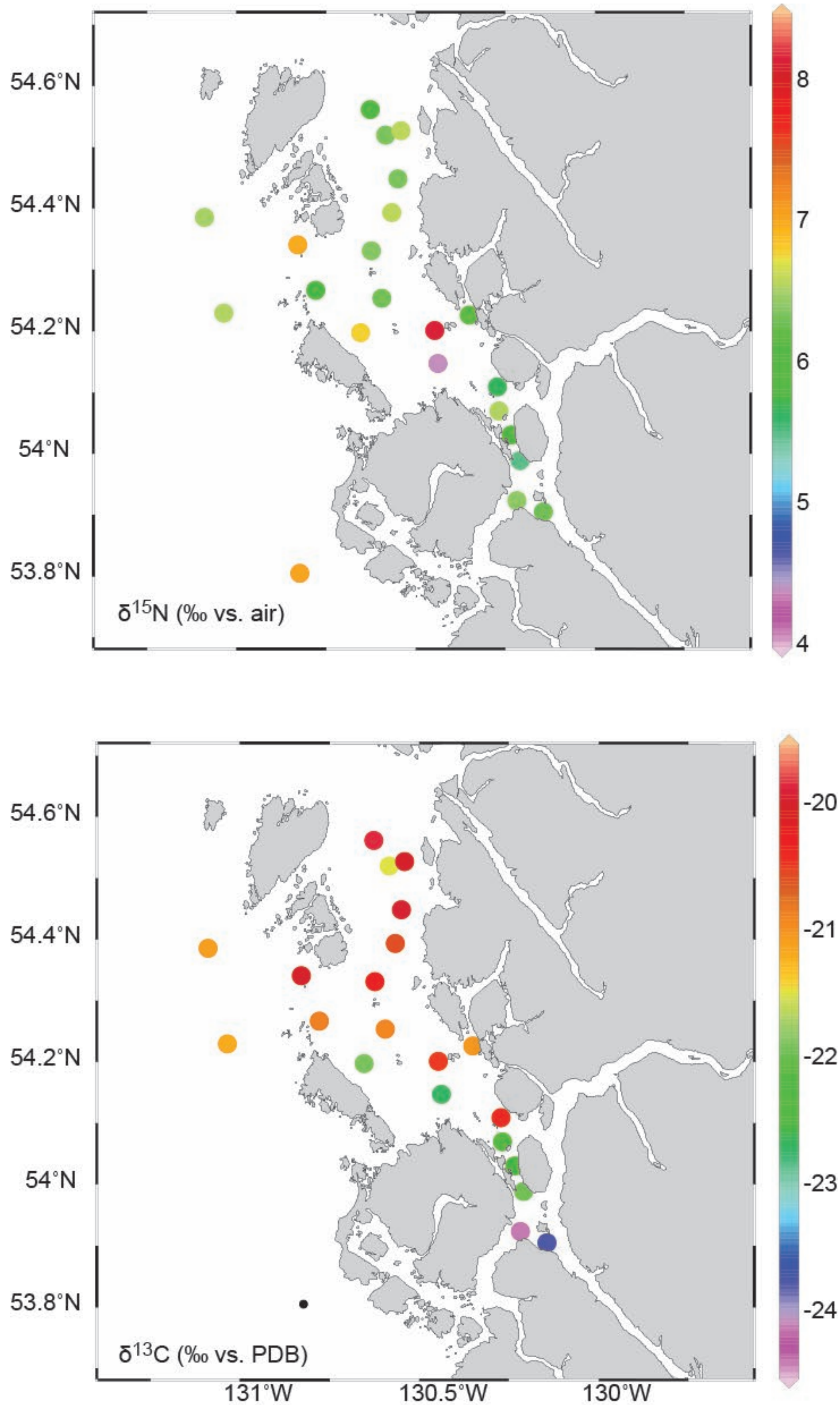

Figure 50. Results of the GFF suspended particulate matter analysis collected on 2019-069, Chatham Sound and Hecate Strait Regions combined.

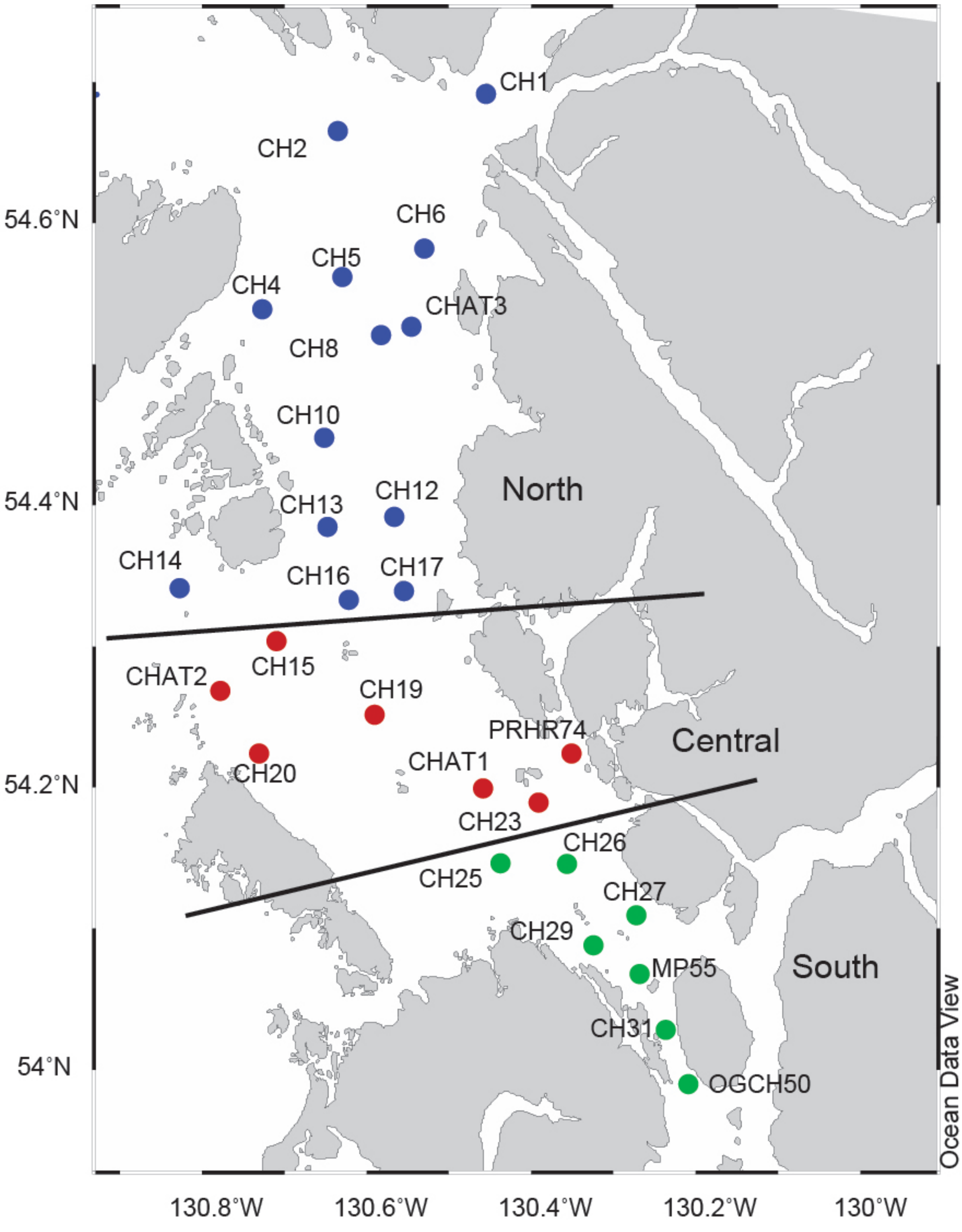

Figure 51. Chatham Sound Region station map, 2020-001.

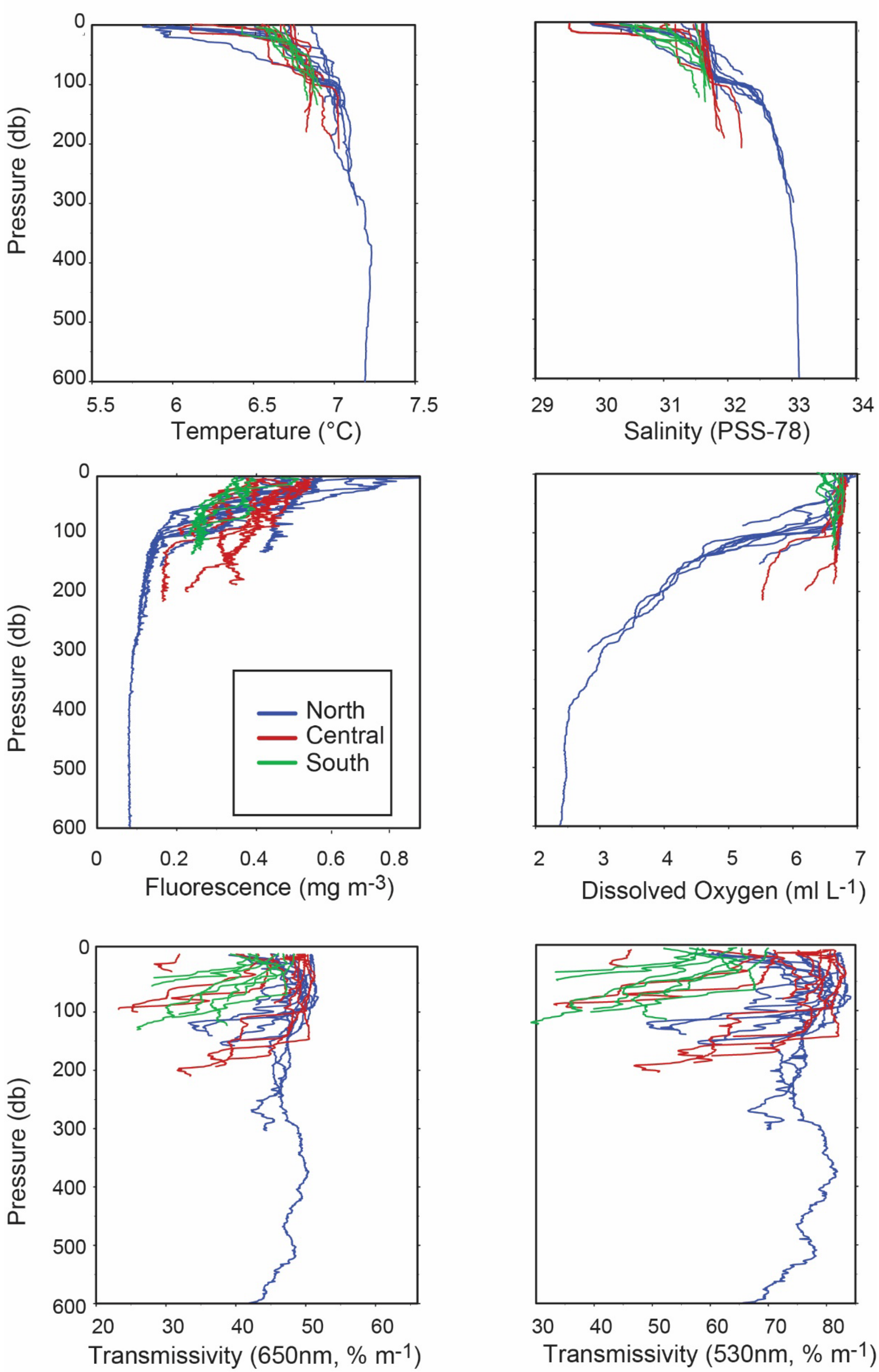

Figure 52. SBE911 data collected during 2020-001, Chatham Sound Region.

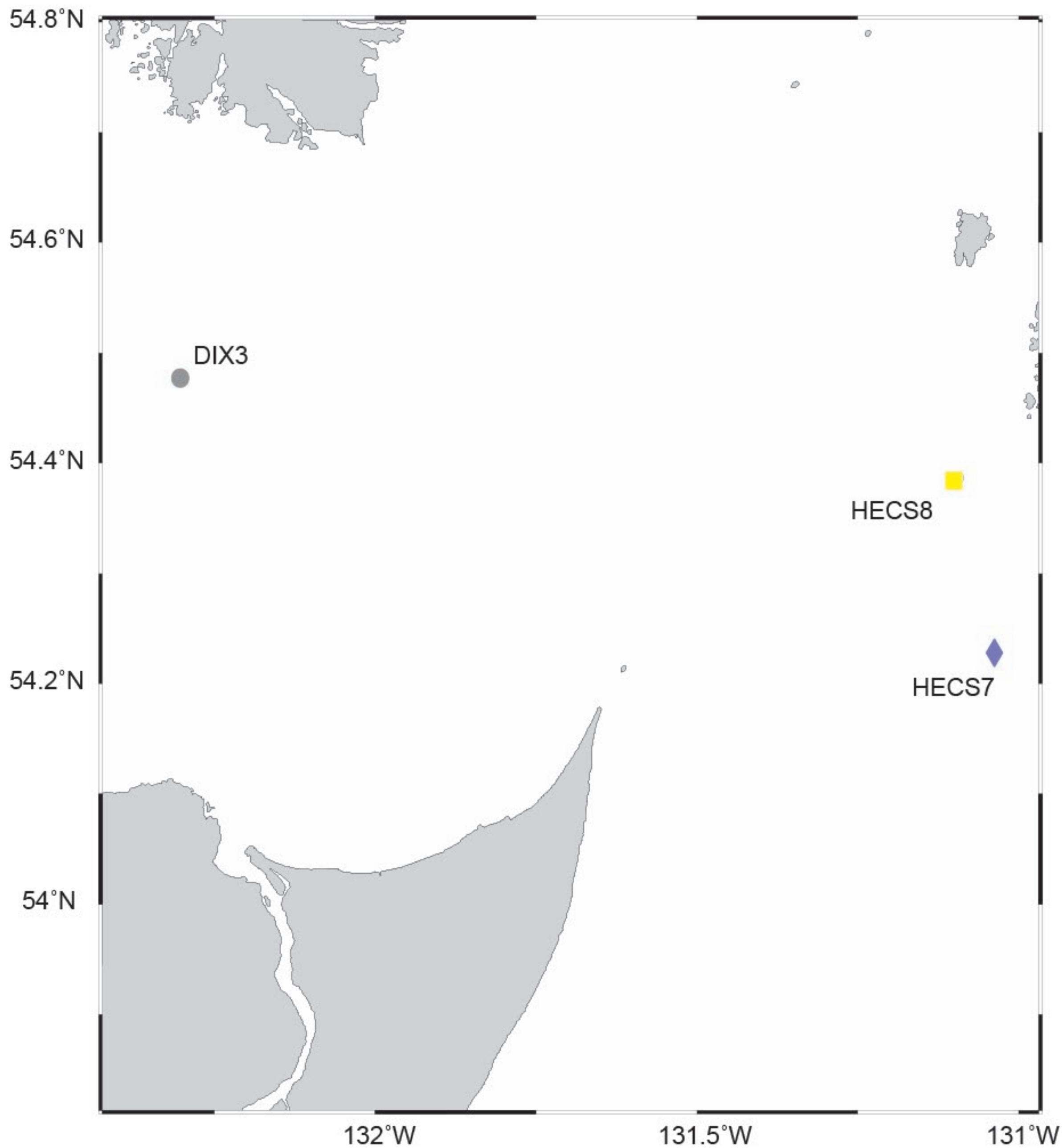

Figure 53. Hecate Strait and Dixon Entrance Regions station map, 2020-001.

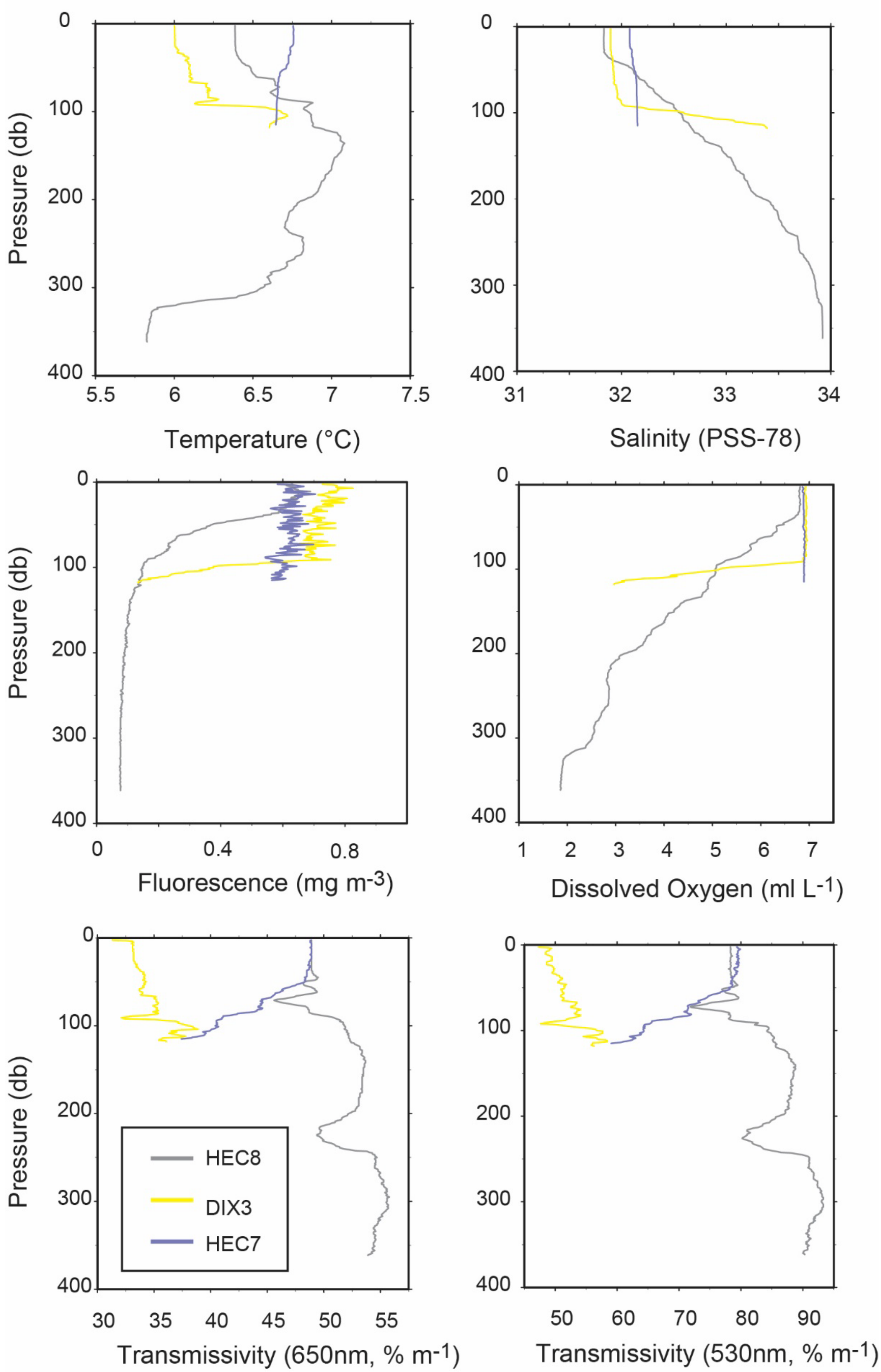

Figure 54. SBE911 data collected during 2020-001, Hecate Strait and Dixon Entrance Regions.

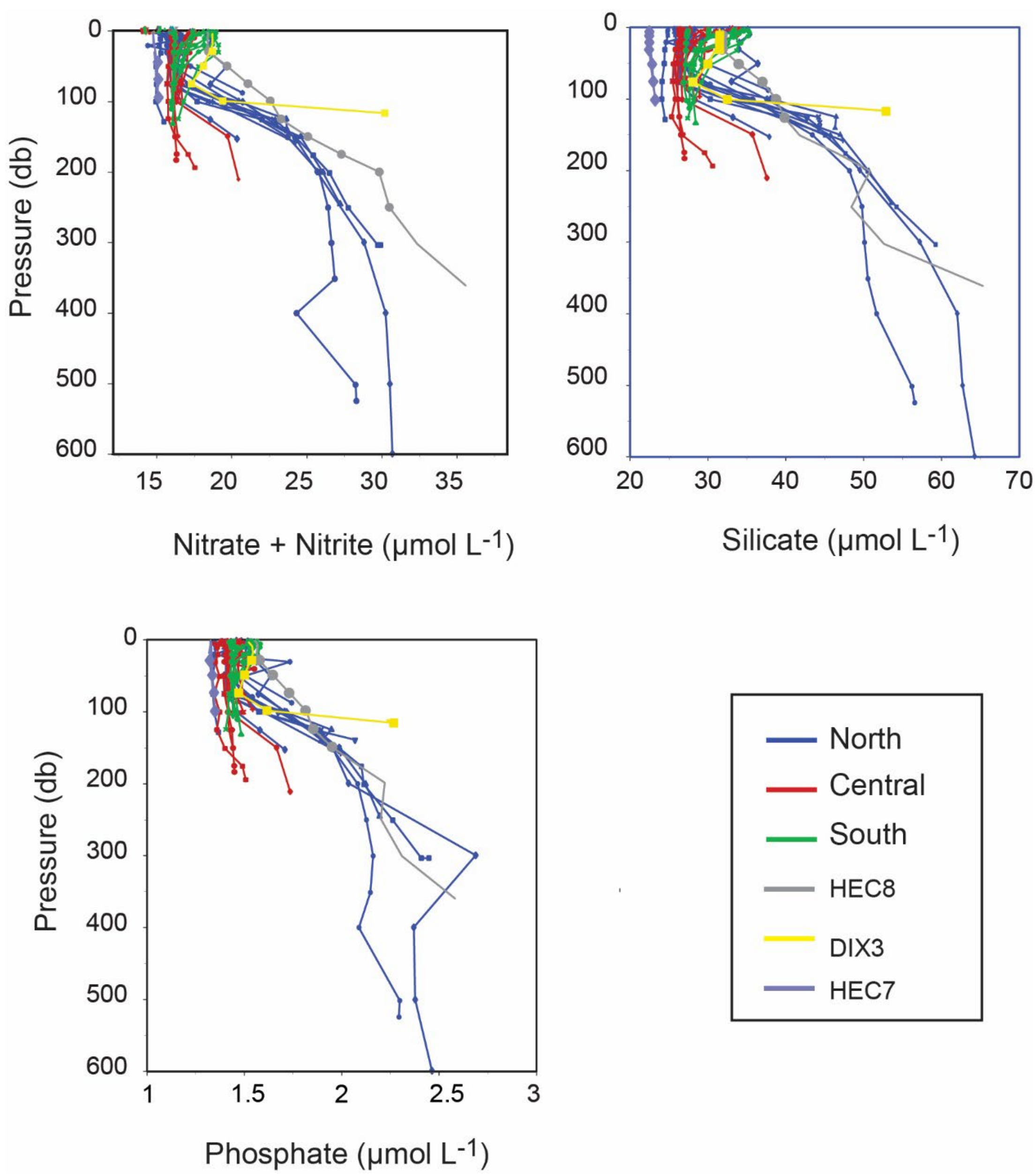

Figure 55. Niskin bottle data collected during 2020-001, all regions shown.

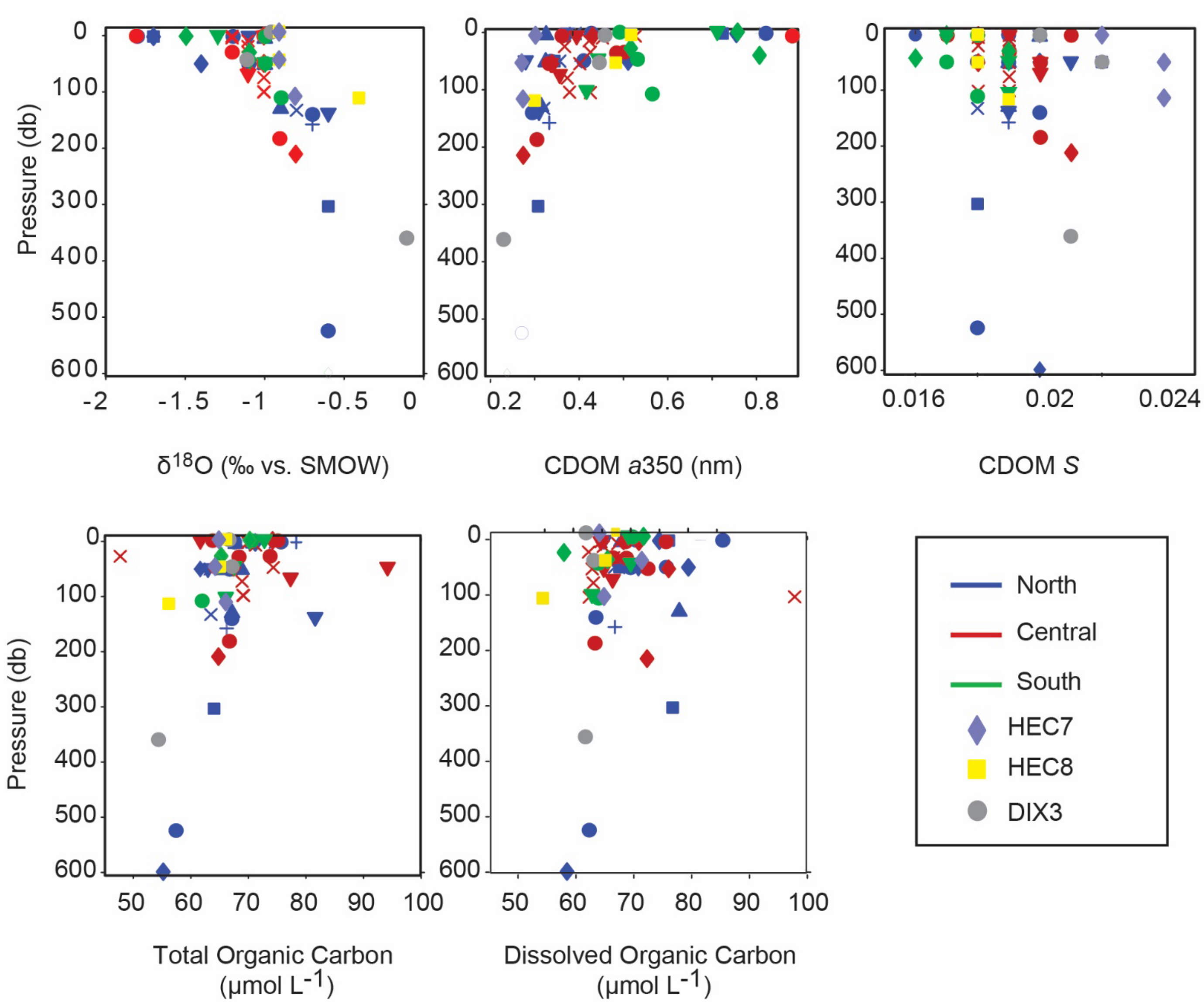

Figure 55 continued. Niskin bottle data collected during 2020-001, all regions shown.

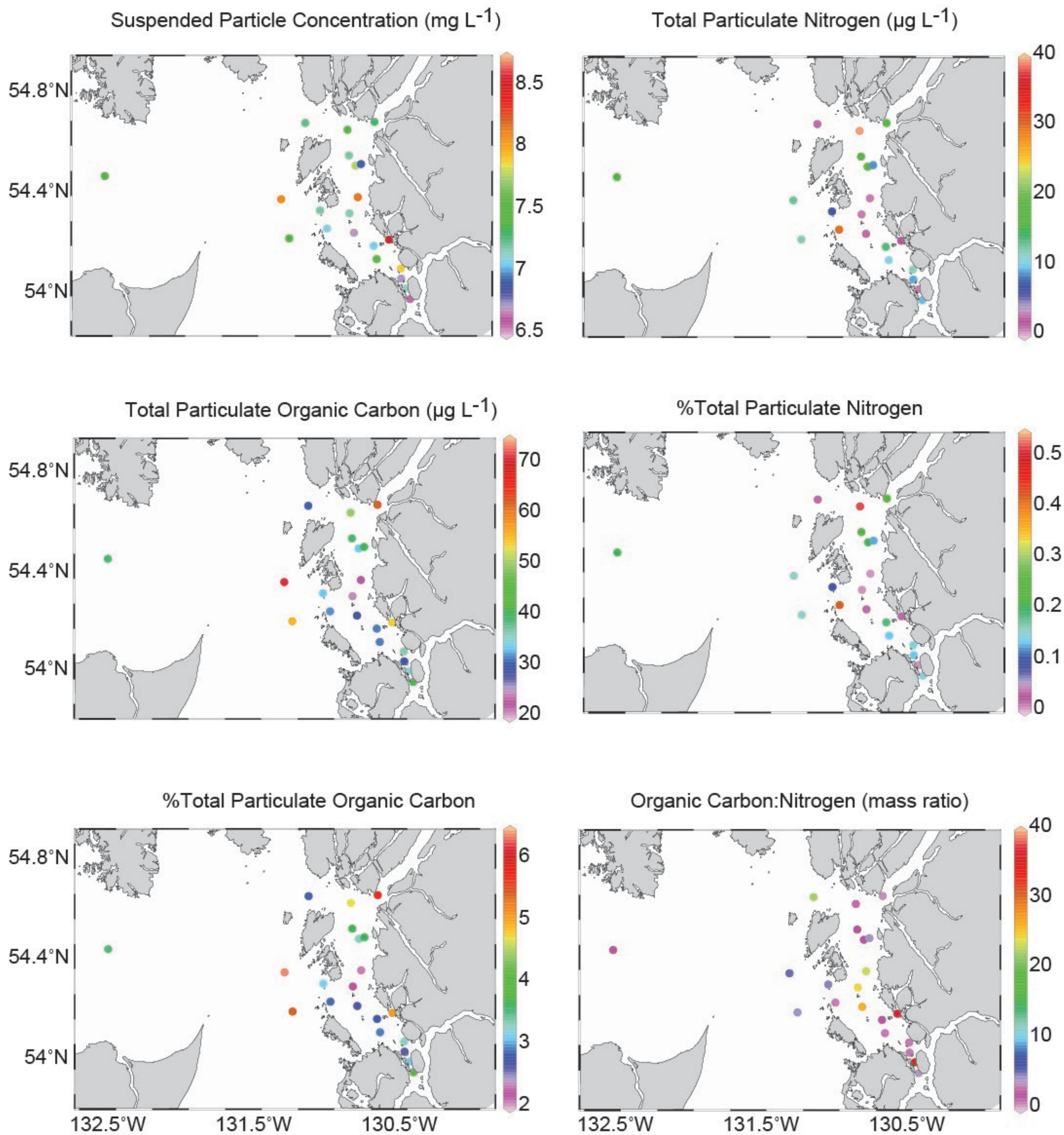

Figure 56. Results of the GFF suspended particulate matter analysis collected on 2020-001 all regions show.

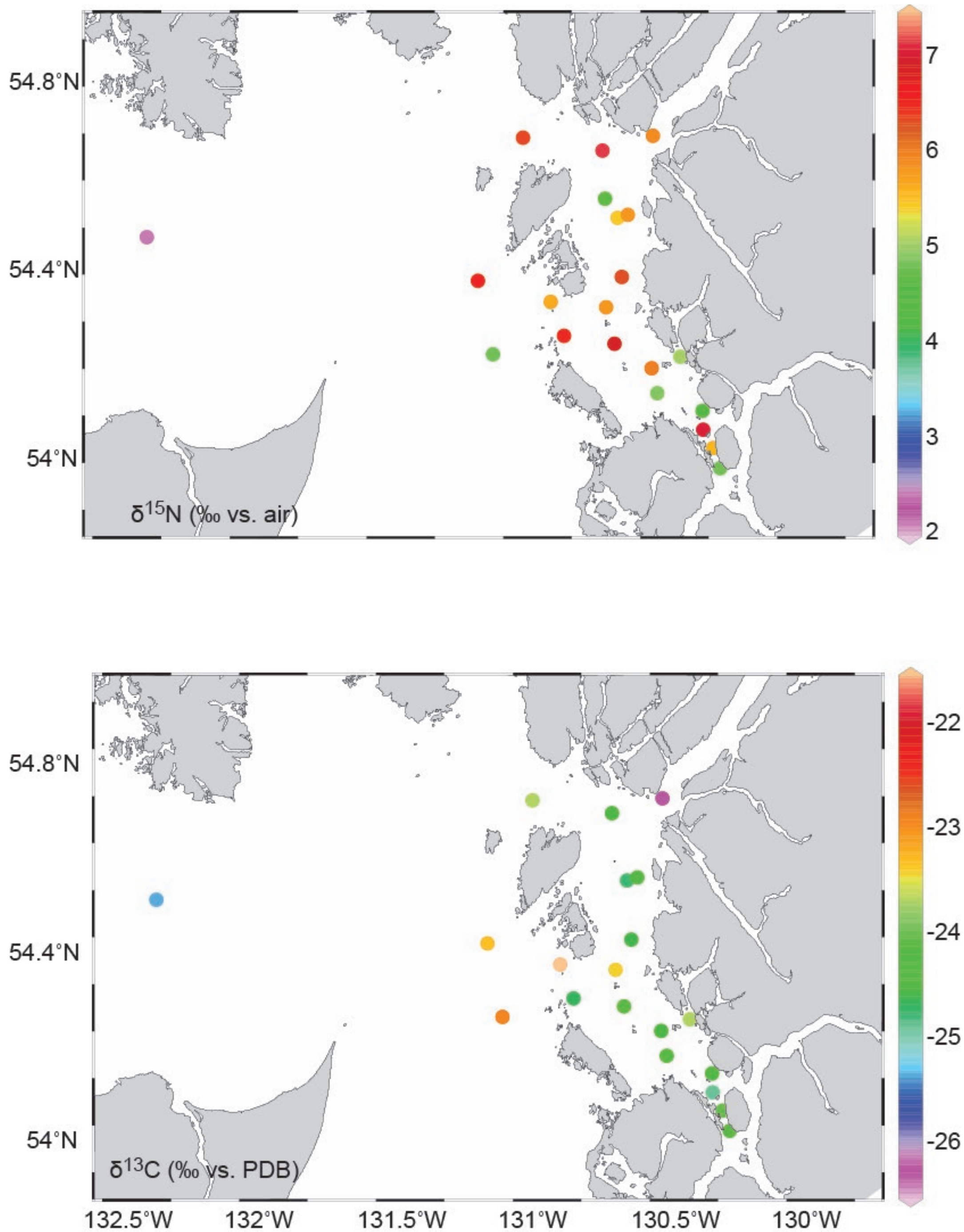

Figure 56 continued. Results of the GFF suspended particulate matter analysis collected on 2020-001 all regions show.

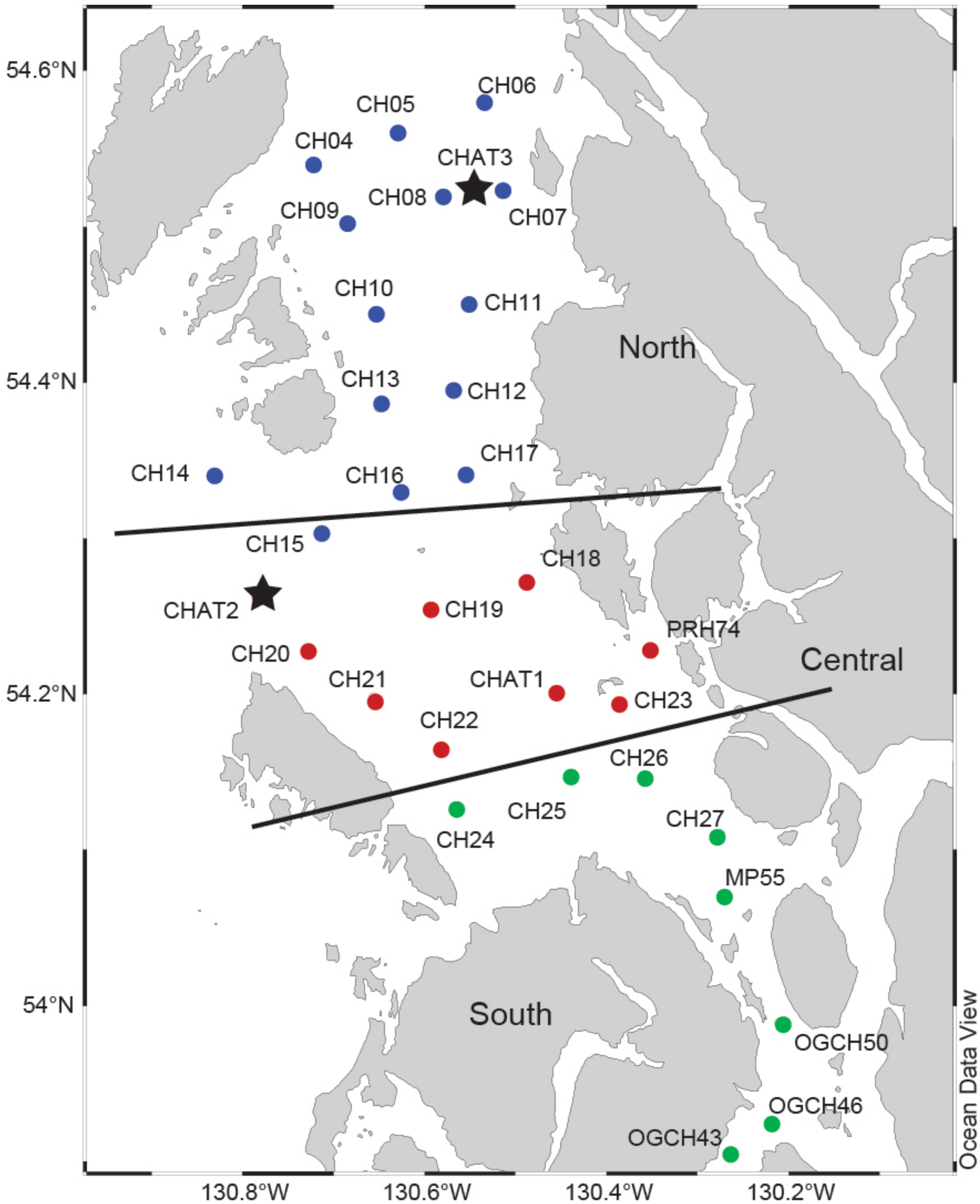

Figure 57. Chatham Sound Region station map, 2020-069. Stars represent mooring stations.

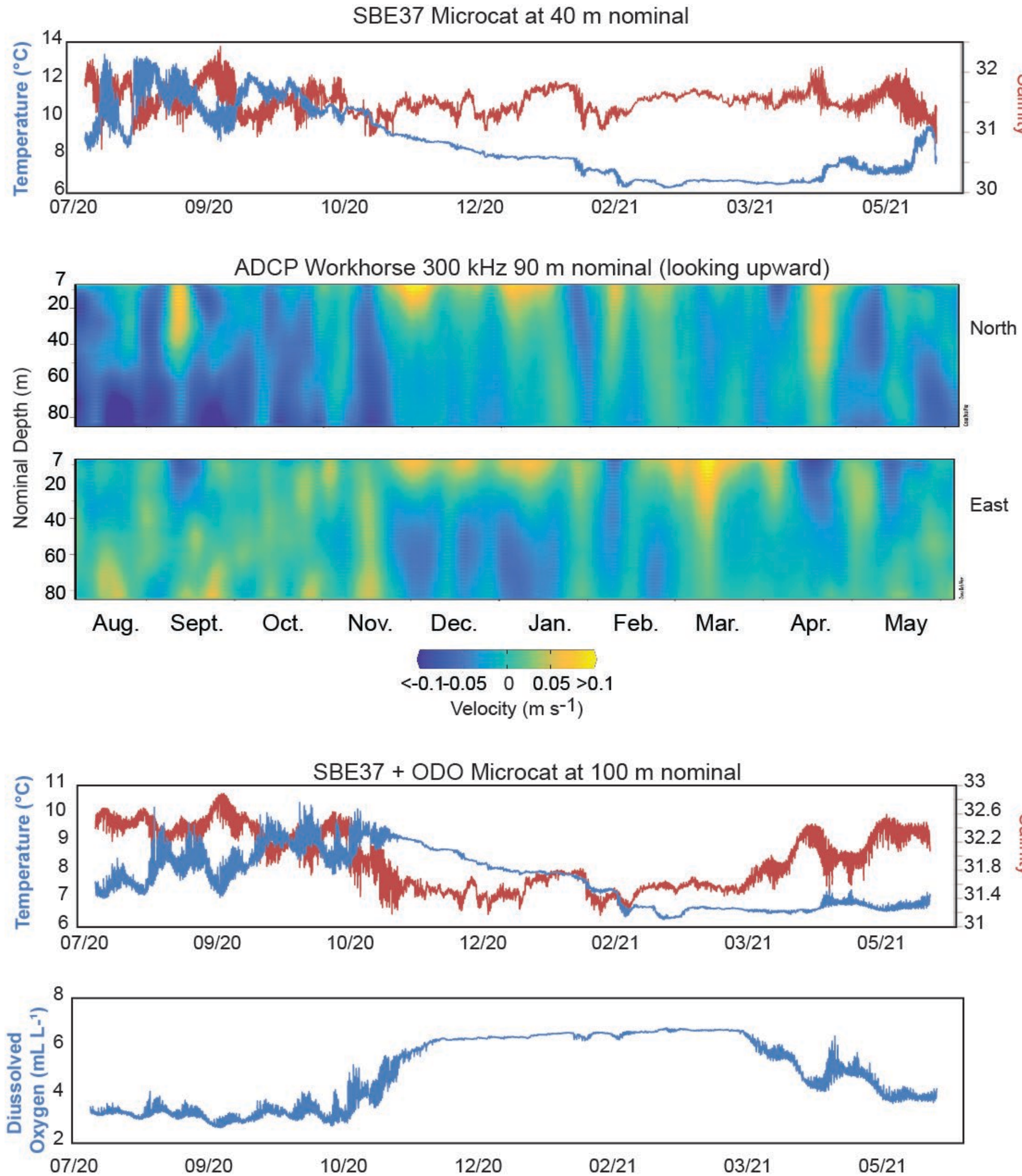

Figure 58. Time series for instrumentation collected at Chat2-3, 2020-2021.

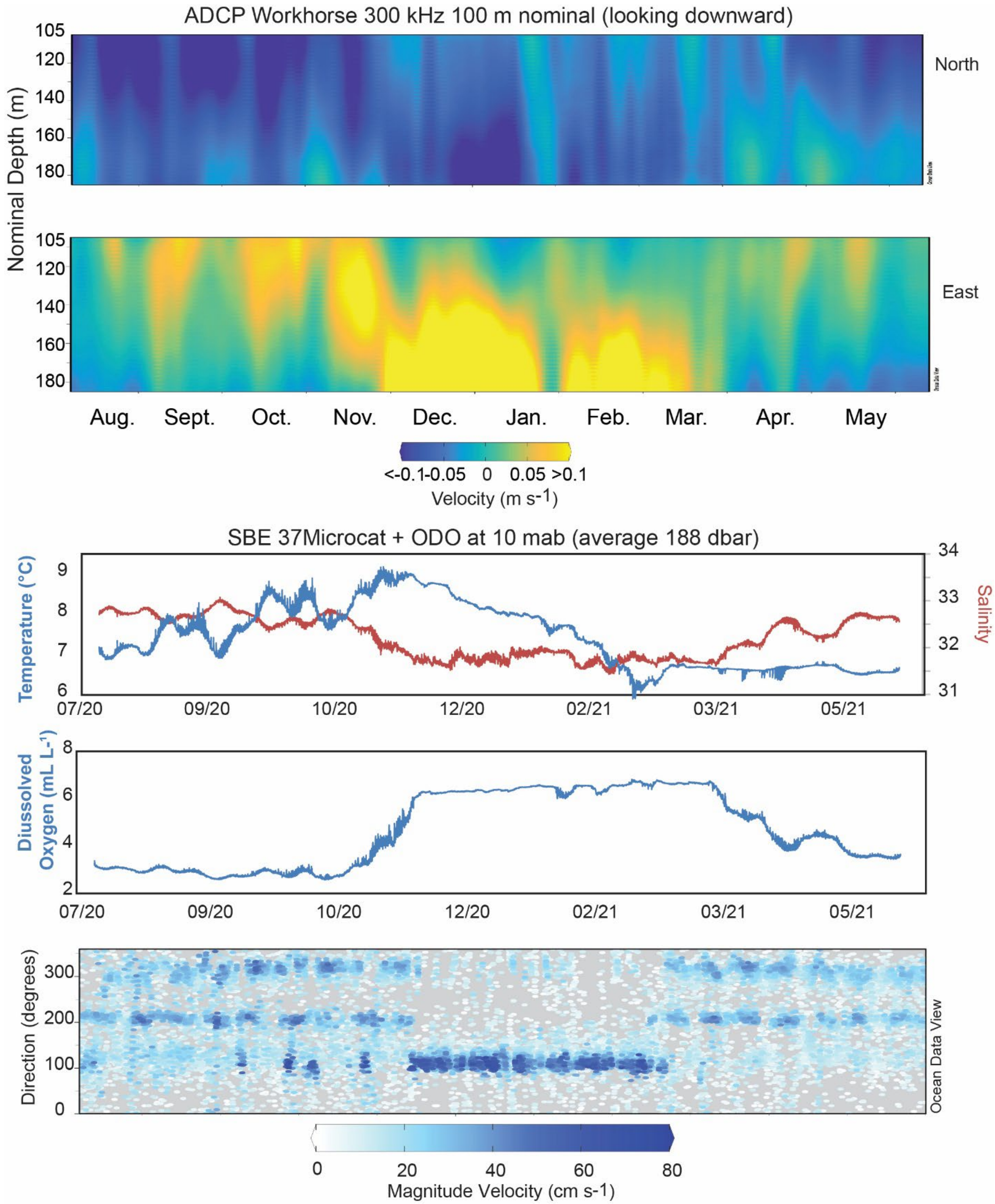

Figure 58 continued. Time series for instrumentation collected at Chat2-3, 2020-2021.

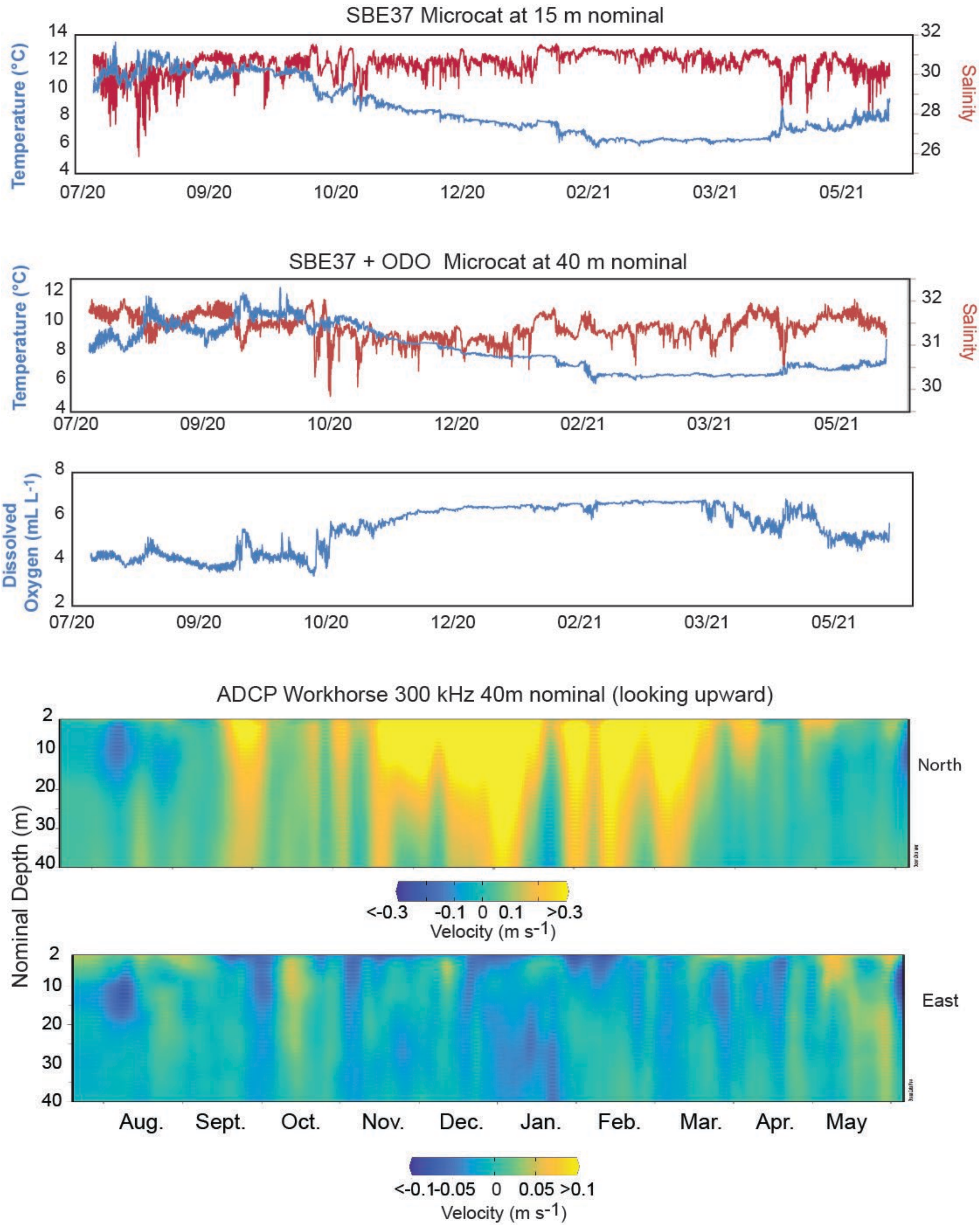

Figure 59. Time series for instrumentation collected at Chat3-2, 2020-2021.

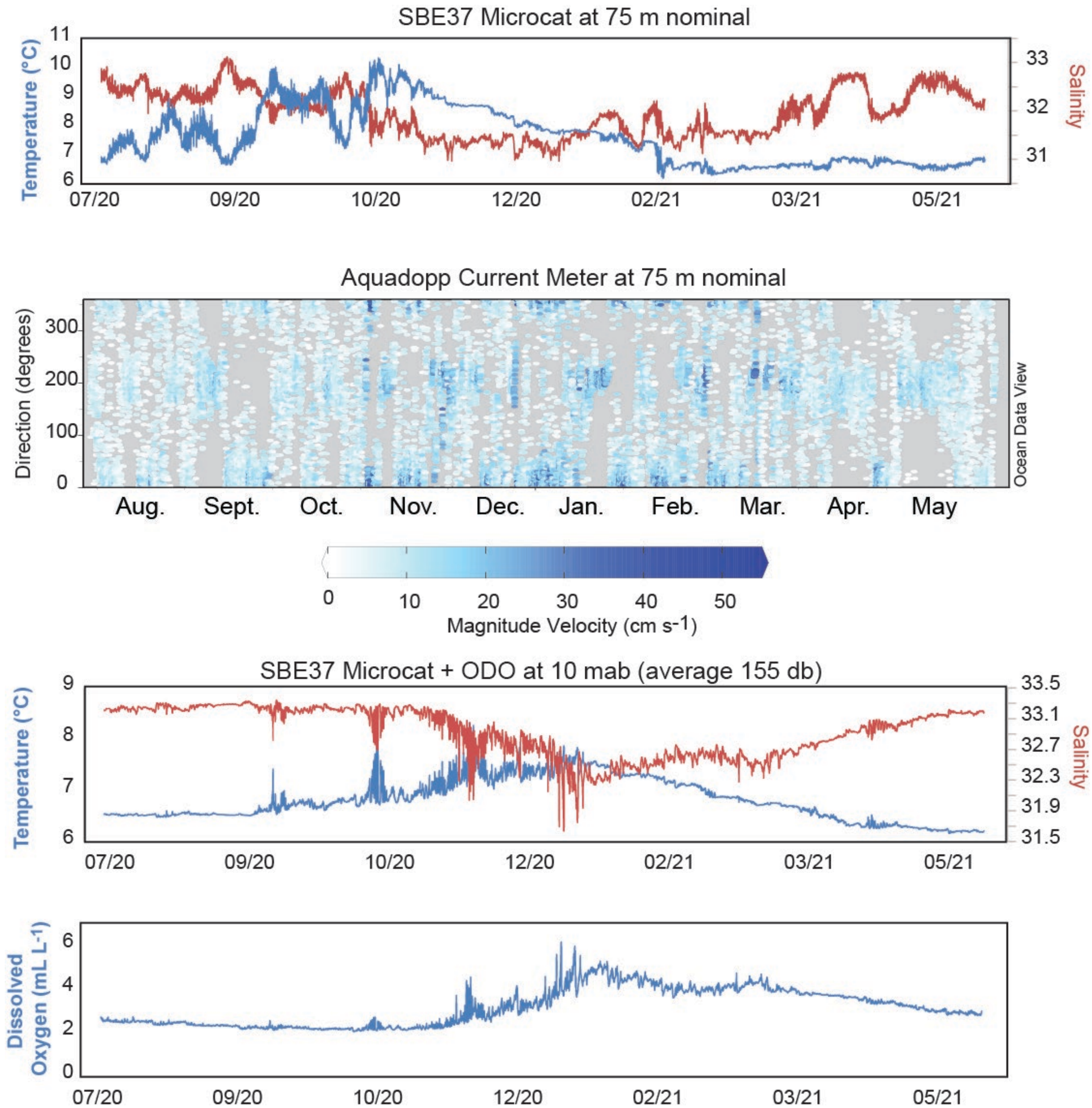

Figure 59 continued. Time series for instrumentation collected at Chat3-2, 2020-2021.

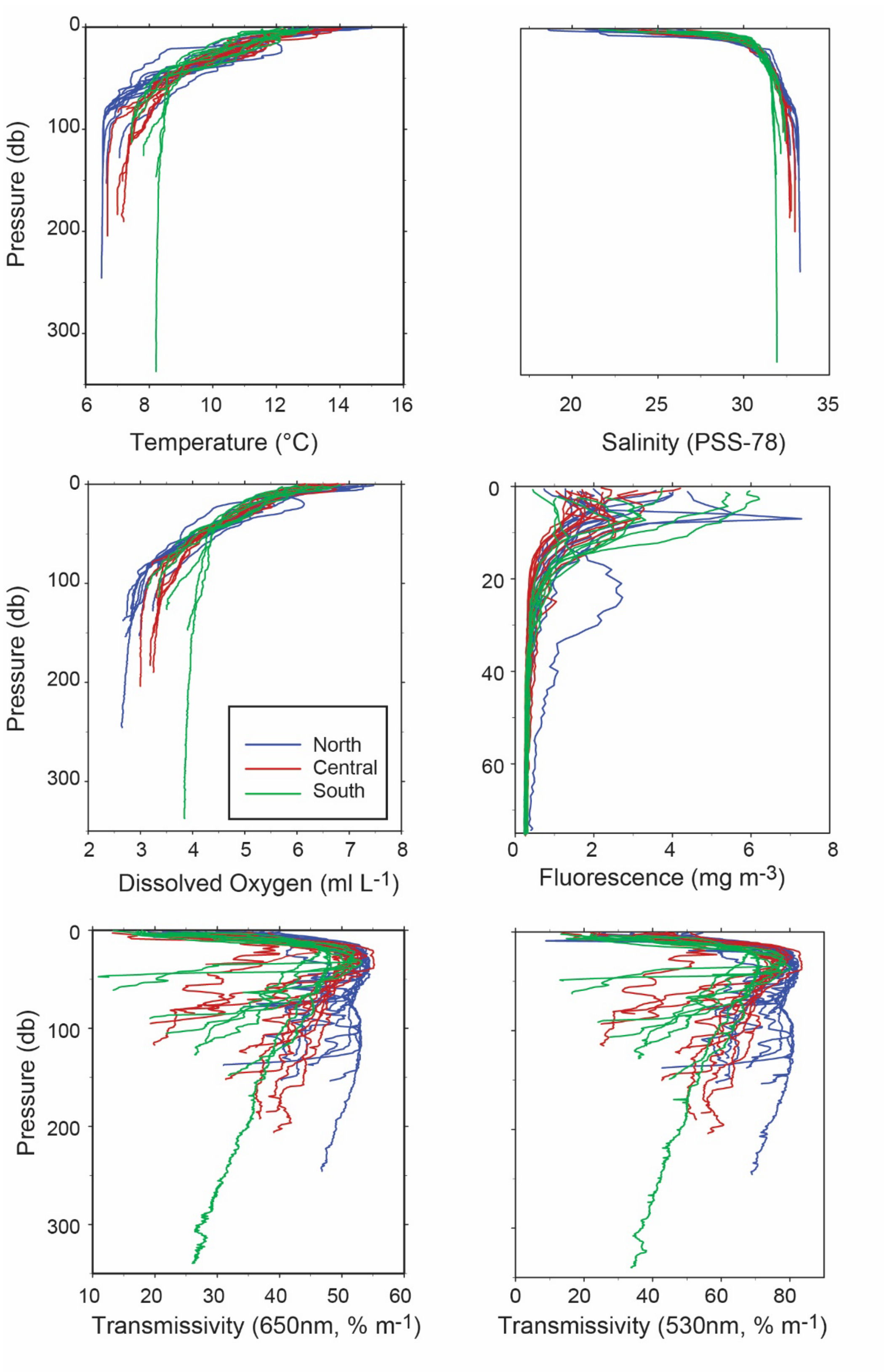

Figure 60. SBE911 data collected on 2020-069, Chatham Sound Region.

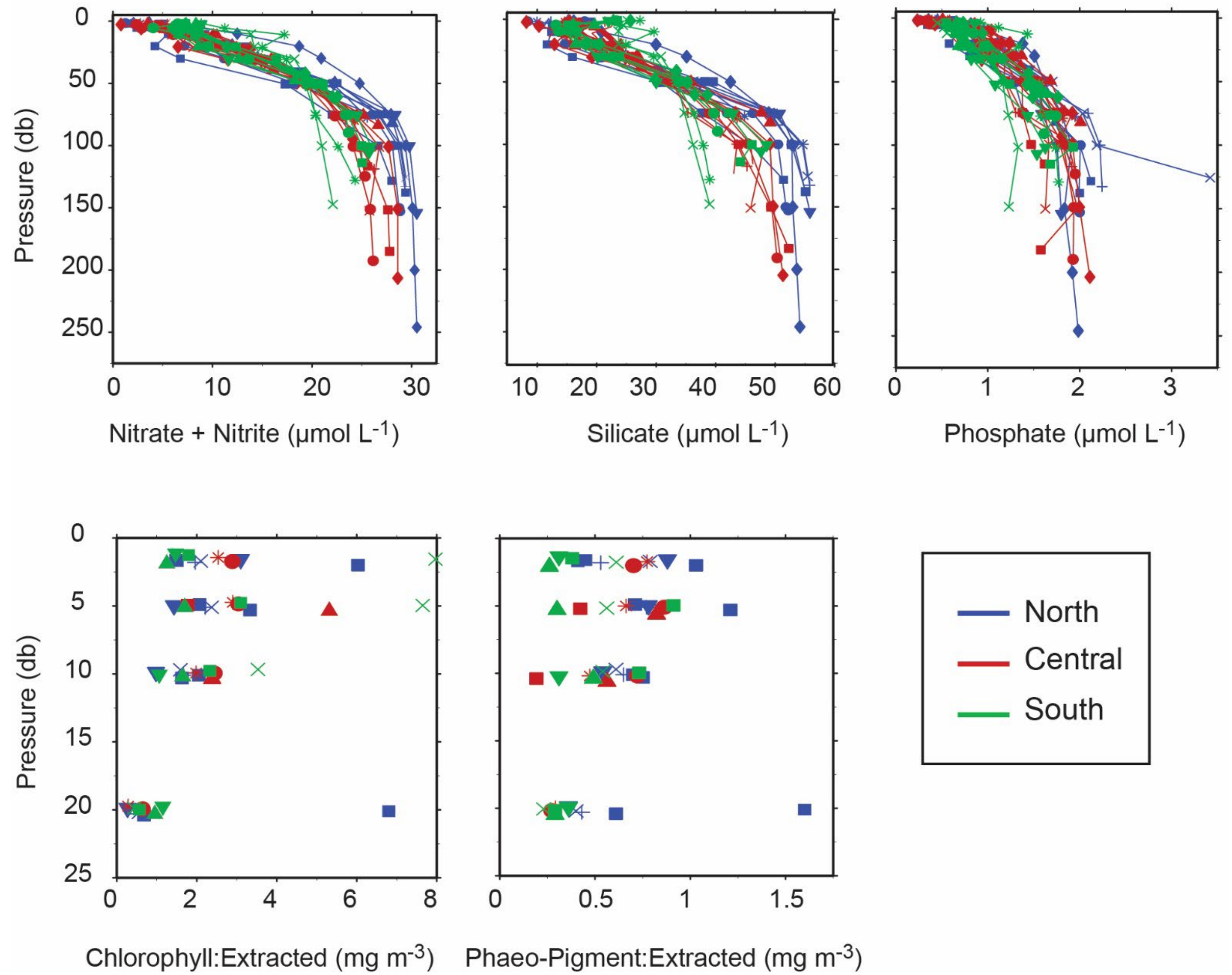

Figure 61. Niskin bottle data collected during 2020-069, Chatham Sound Region.

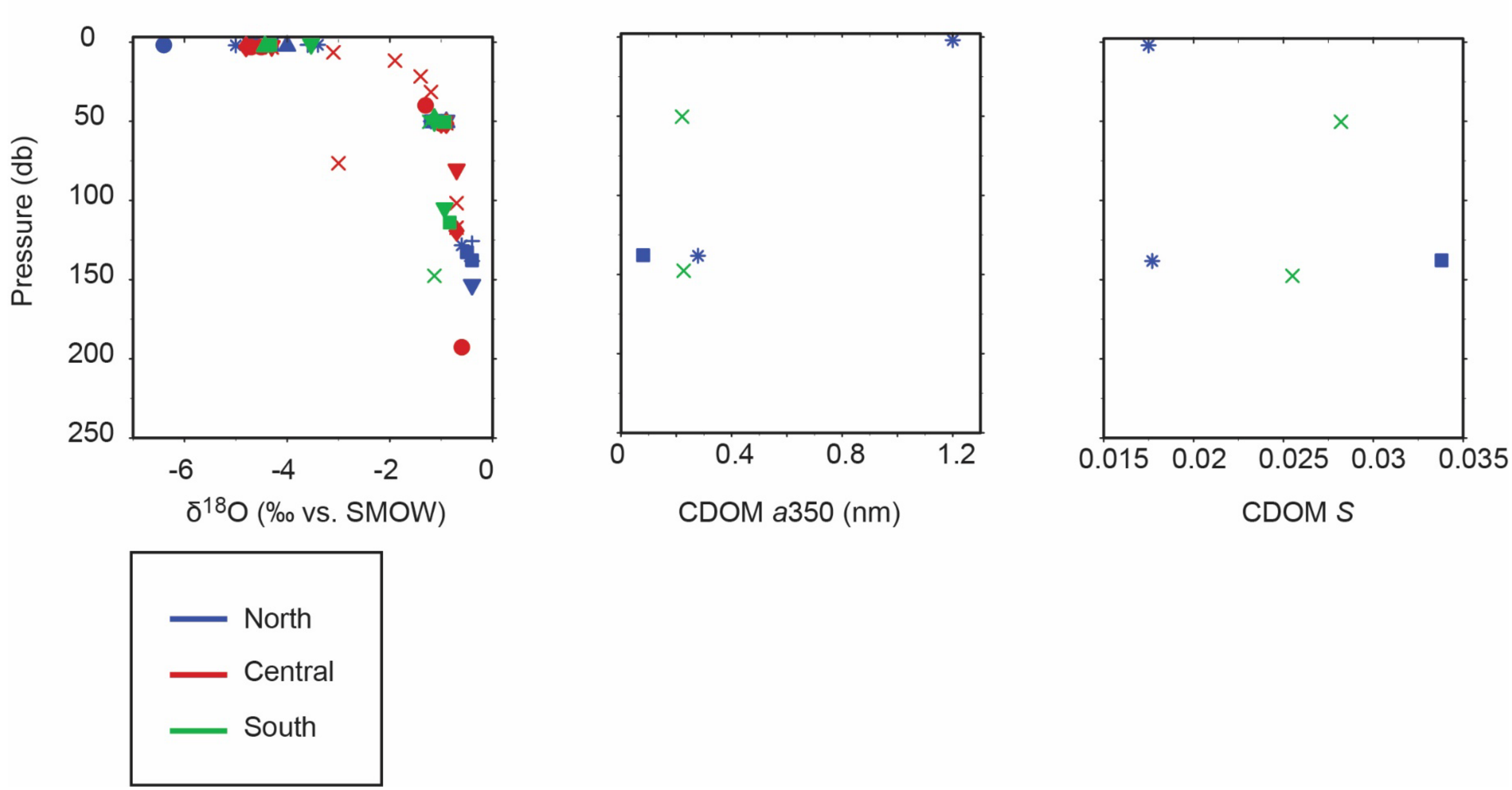

Figure 61 continued. Niskin bottle data collected during 2020-069, Chatham Sound Region.

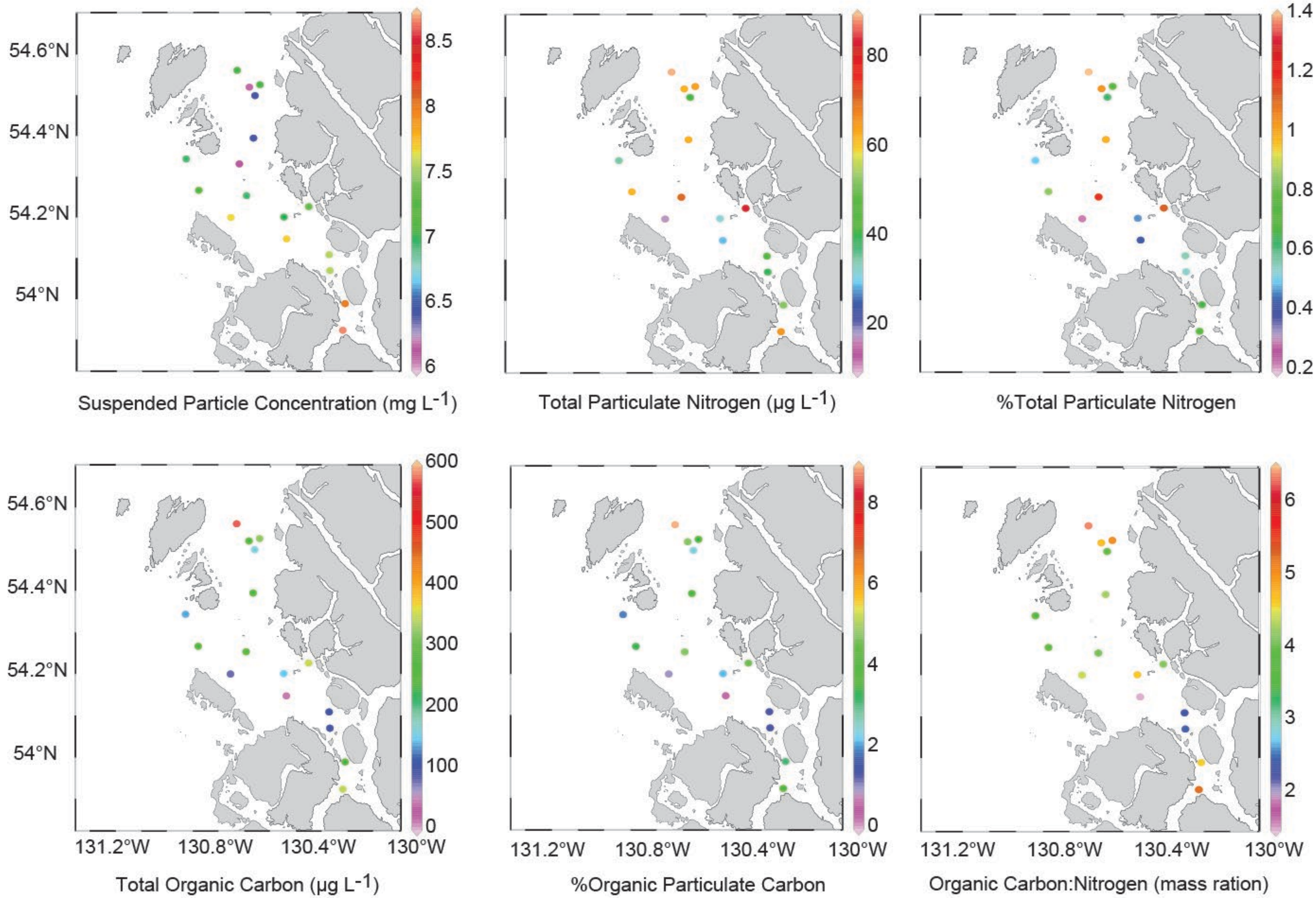

Figure 62. Results of the GFF suspended particulate matter analysis collected on 2020-069, surface niskin samples, Chatham Sound Region.

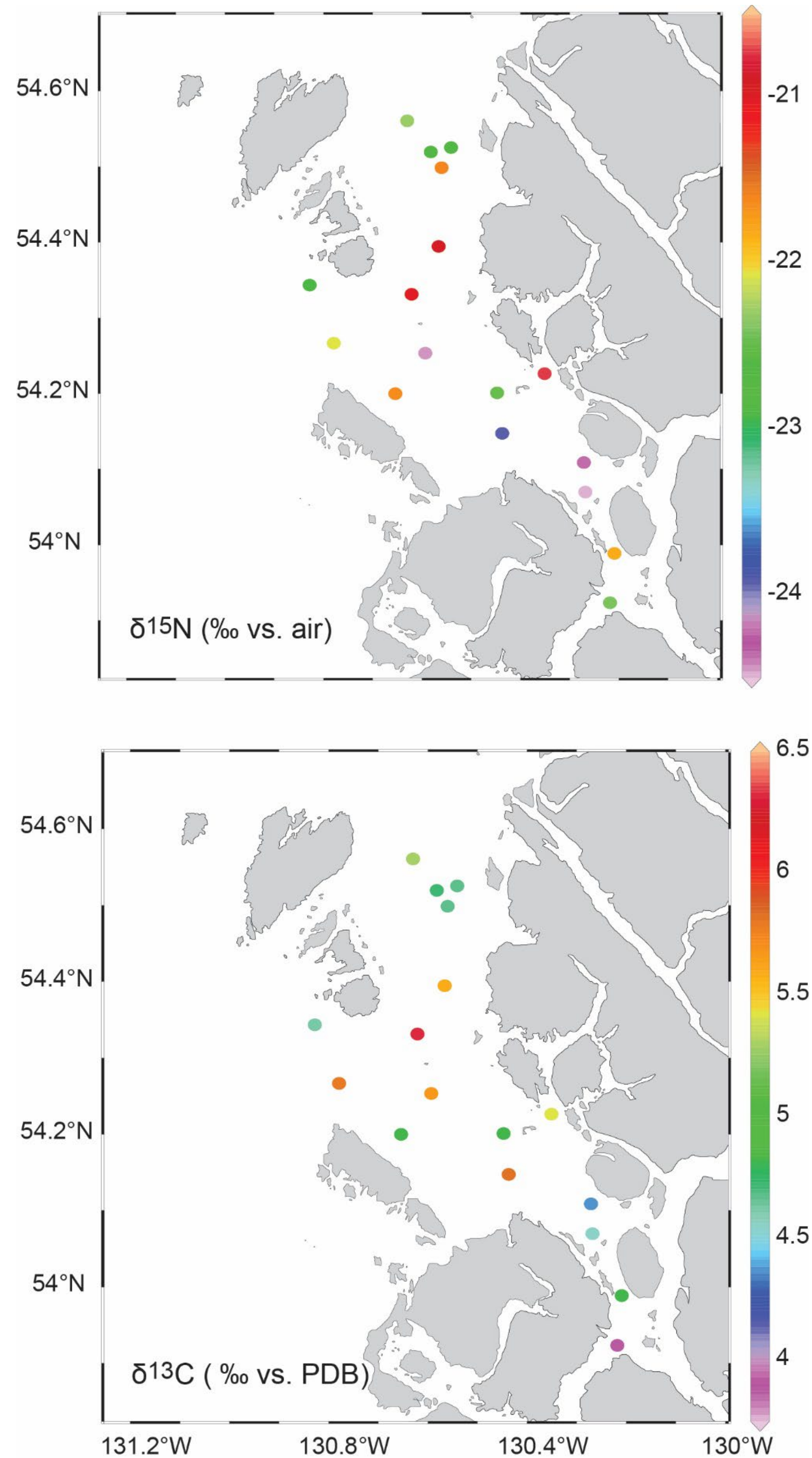

Figure 62 continued. Results of the GFF suspended particulate matter analysis collected on 2020-069, surface niskin samples, Chatham Sound Region.

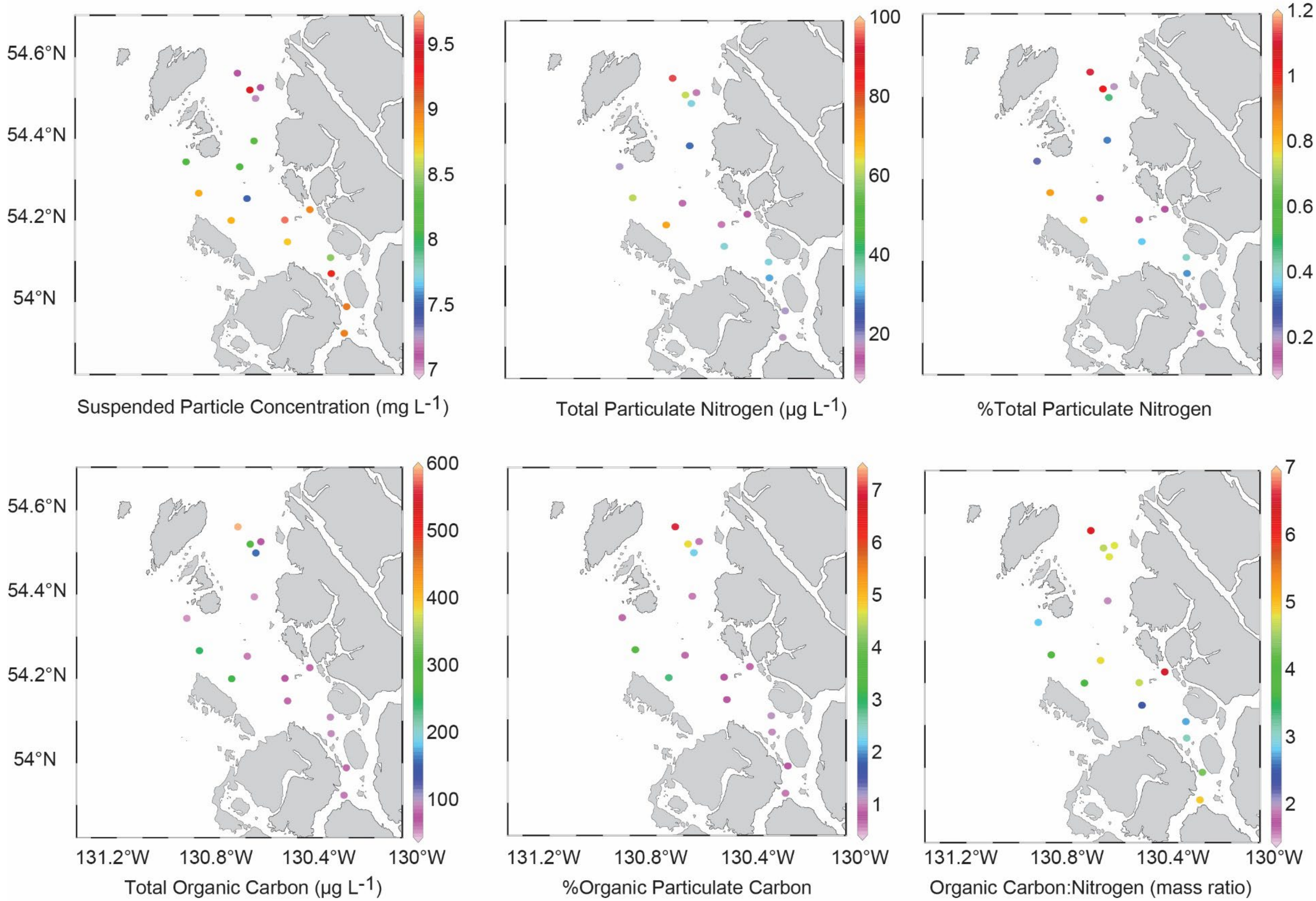

Figure 63. Results of the GFF suspended particulate matter analysis collected on 2020-069, bottom-5m samples, Chatham Sound Region.

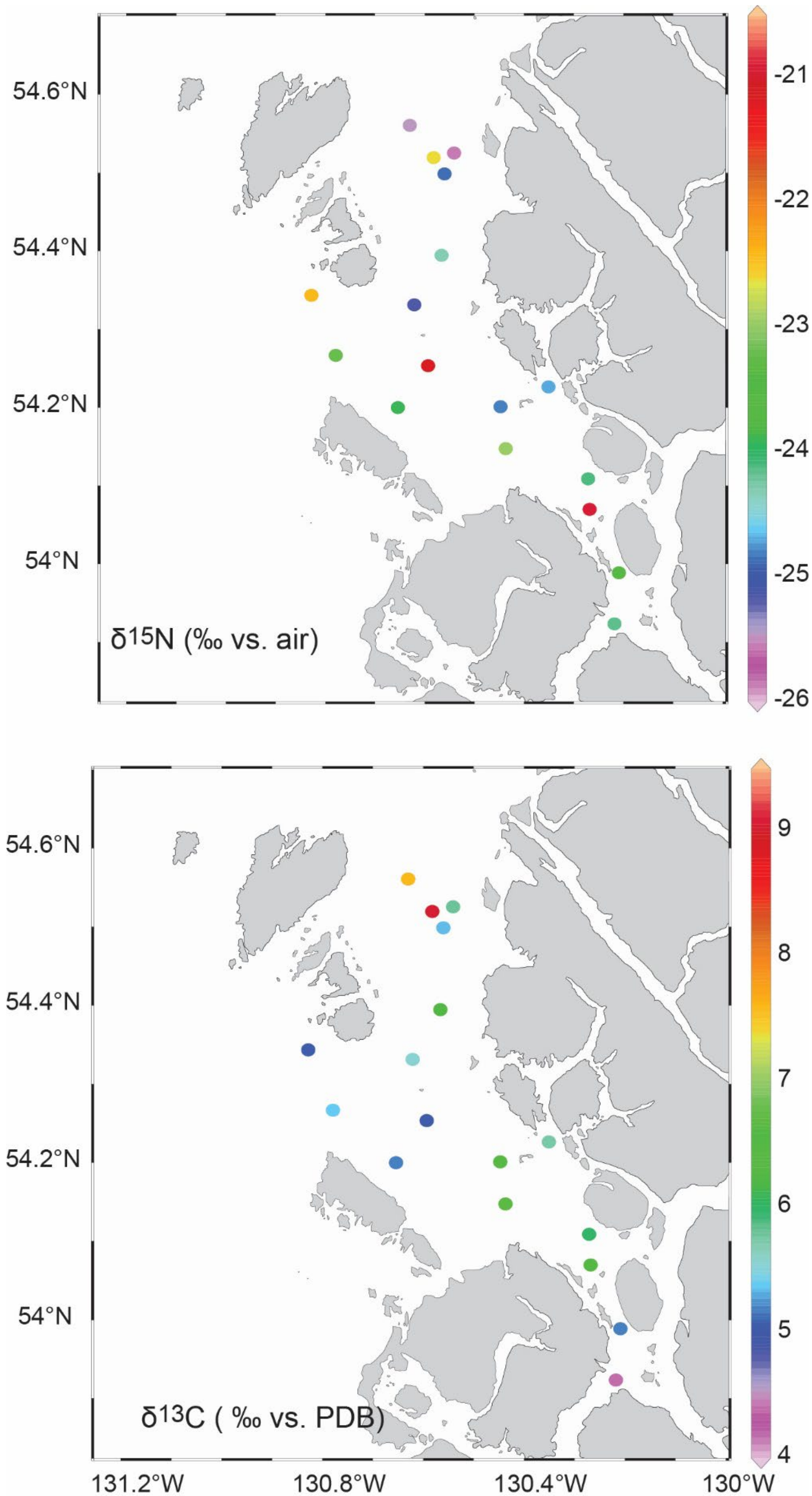

Figure 63 continued. Results of the GFF suspended particulate matter analysis collected on 2020-069, bottom-5m samples, Chatham Sound Region.

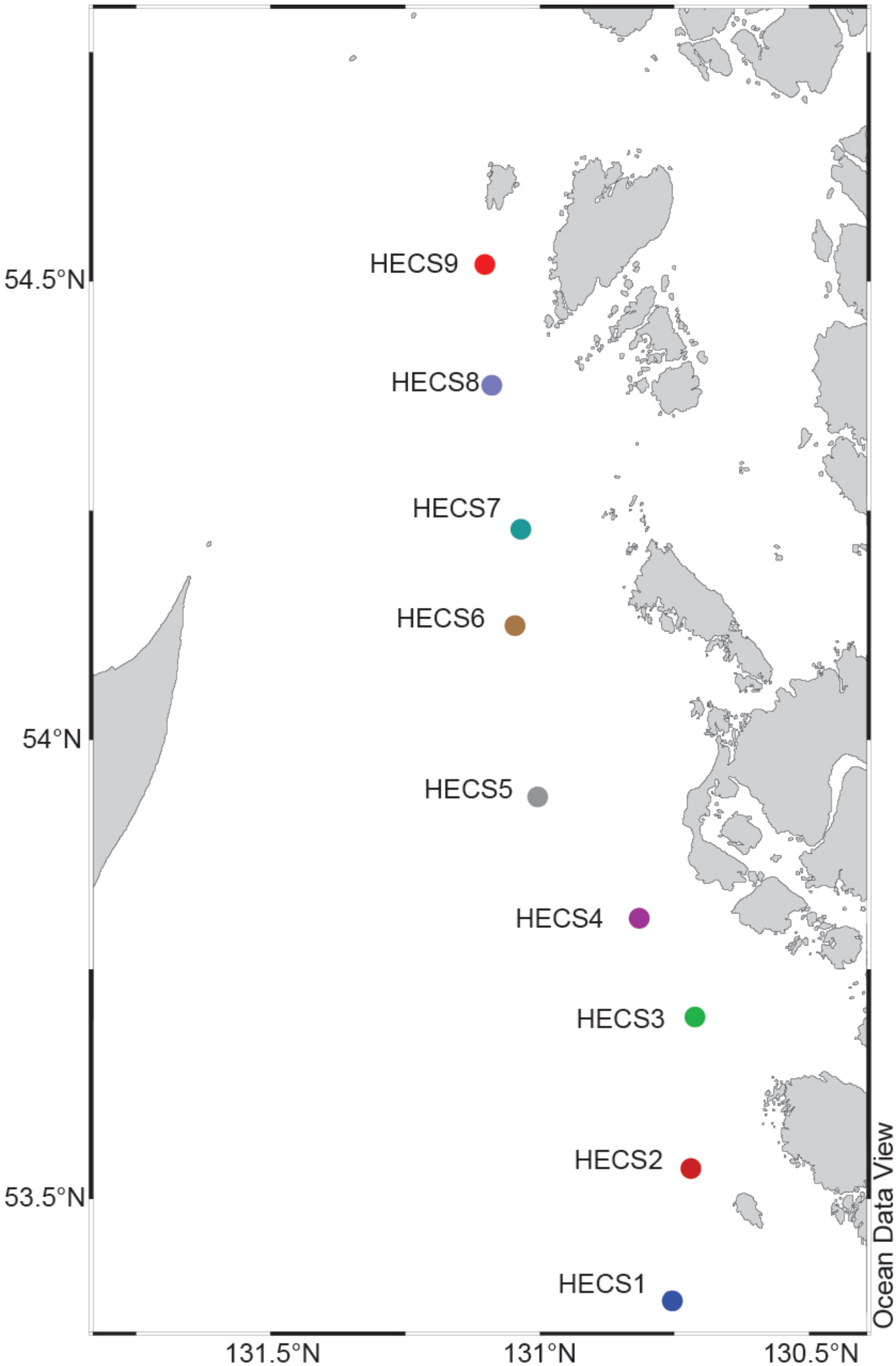

Figure 64. Hecate Strait Region station map, 2020-069.

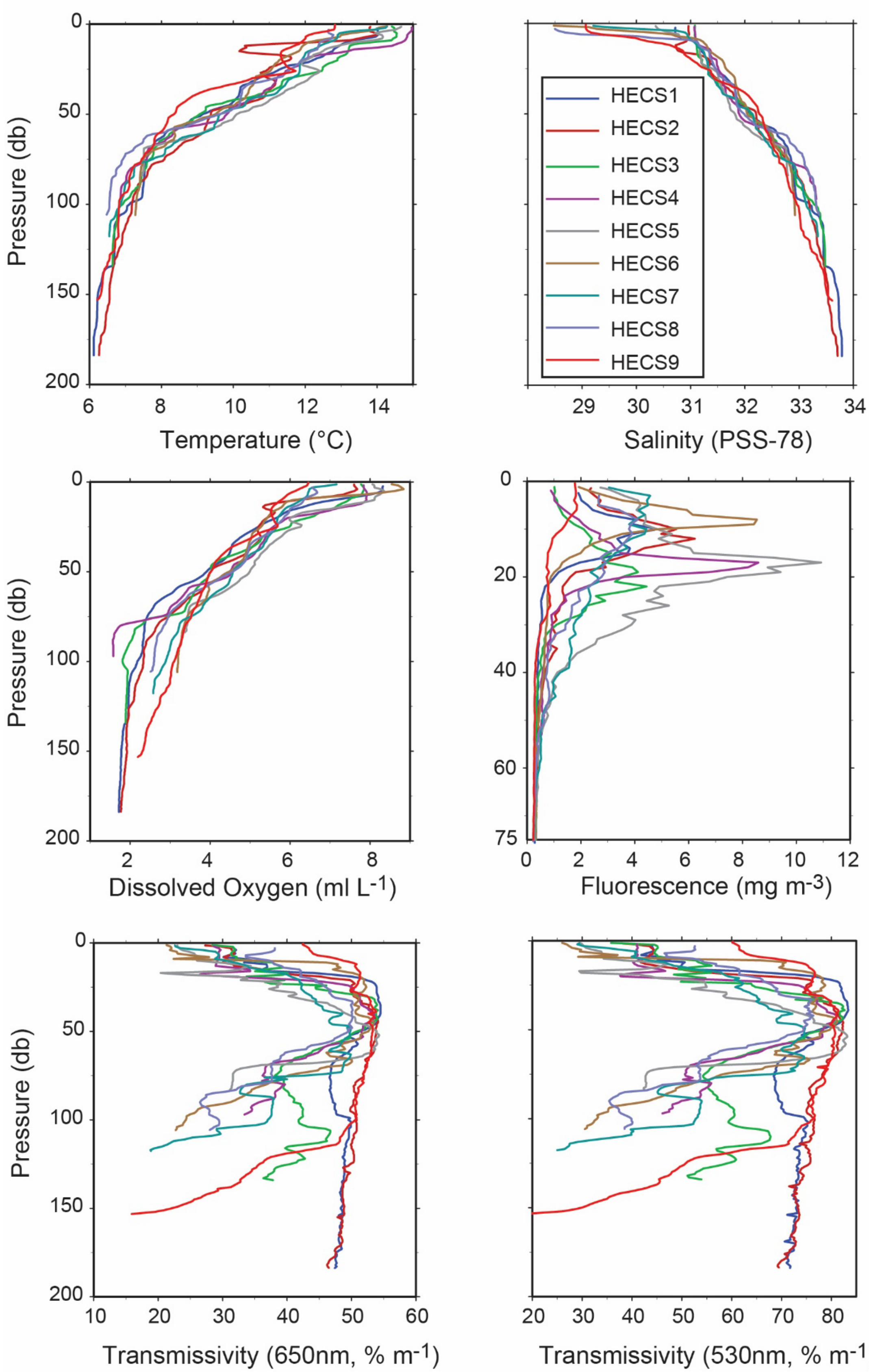

Figure 65. SBE911 data collected during 2020-069, Hecate Strait Region.

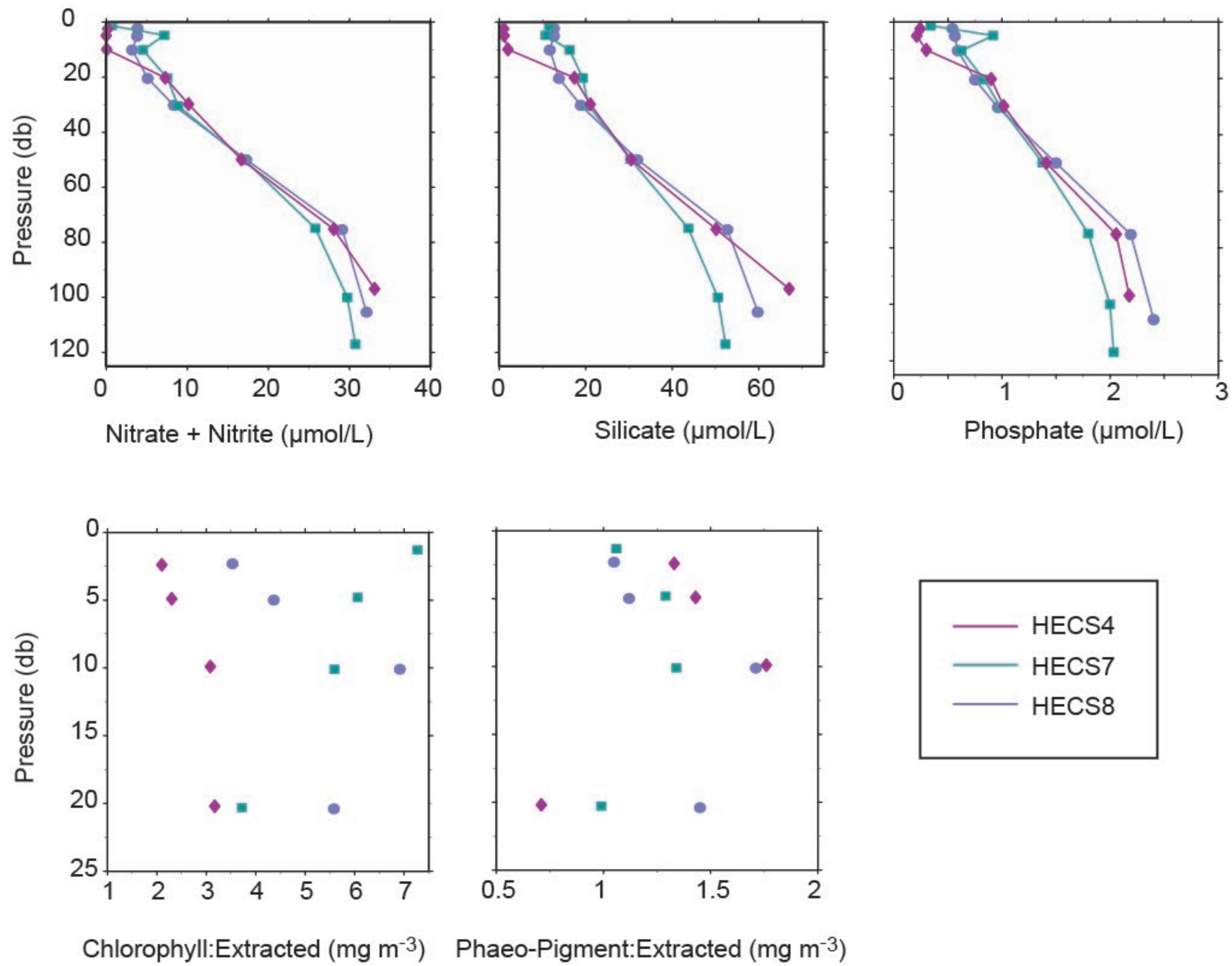

Figure 66. Niskin sample data collected during 2020-069, Hecate Strait Region.

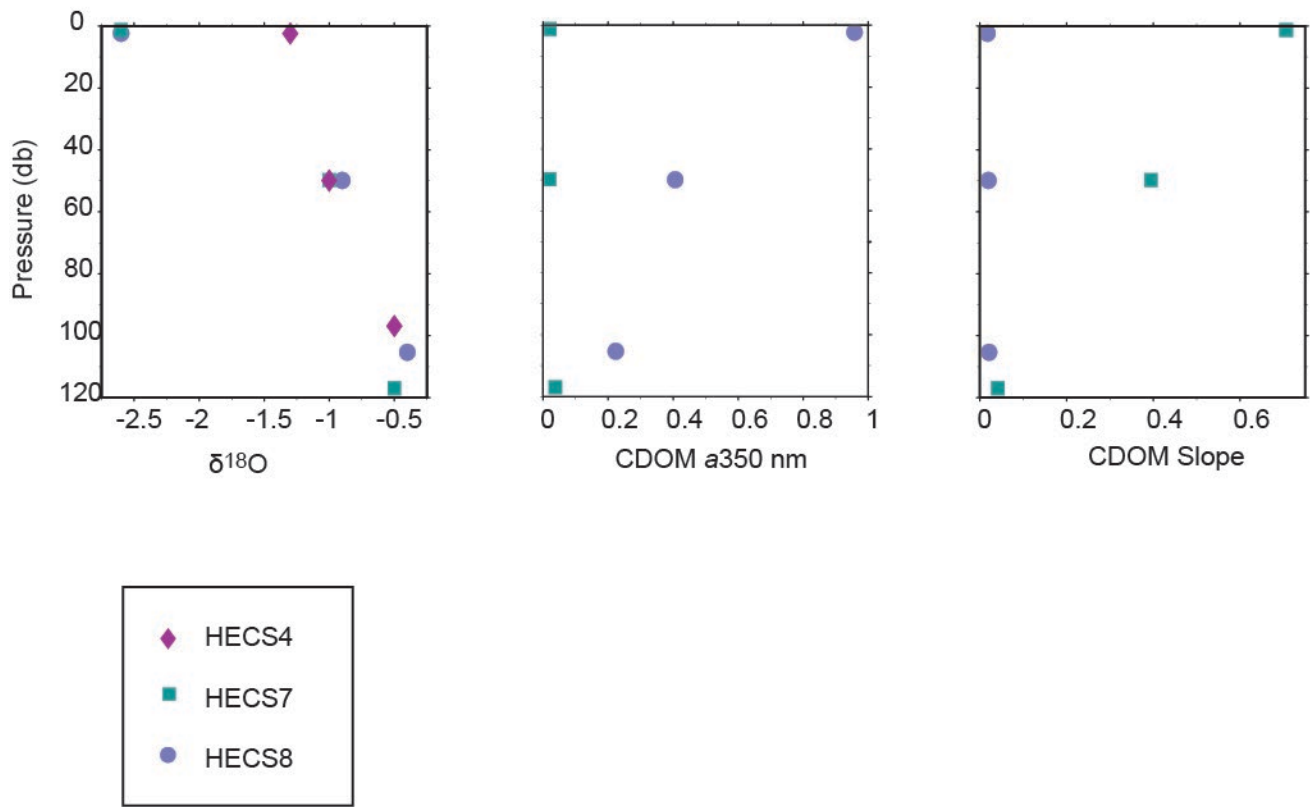

Figure 66 continued. Niskin sample data collected during 2020-069, Hecate Strait Region.

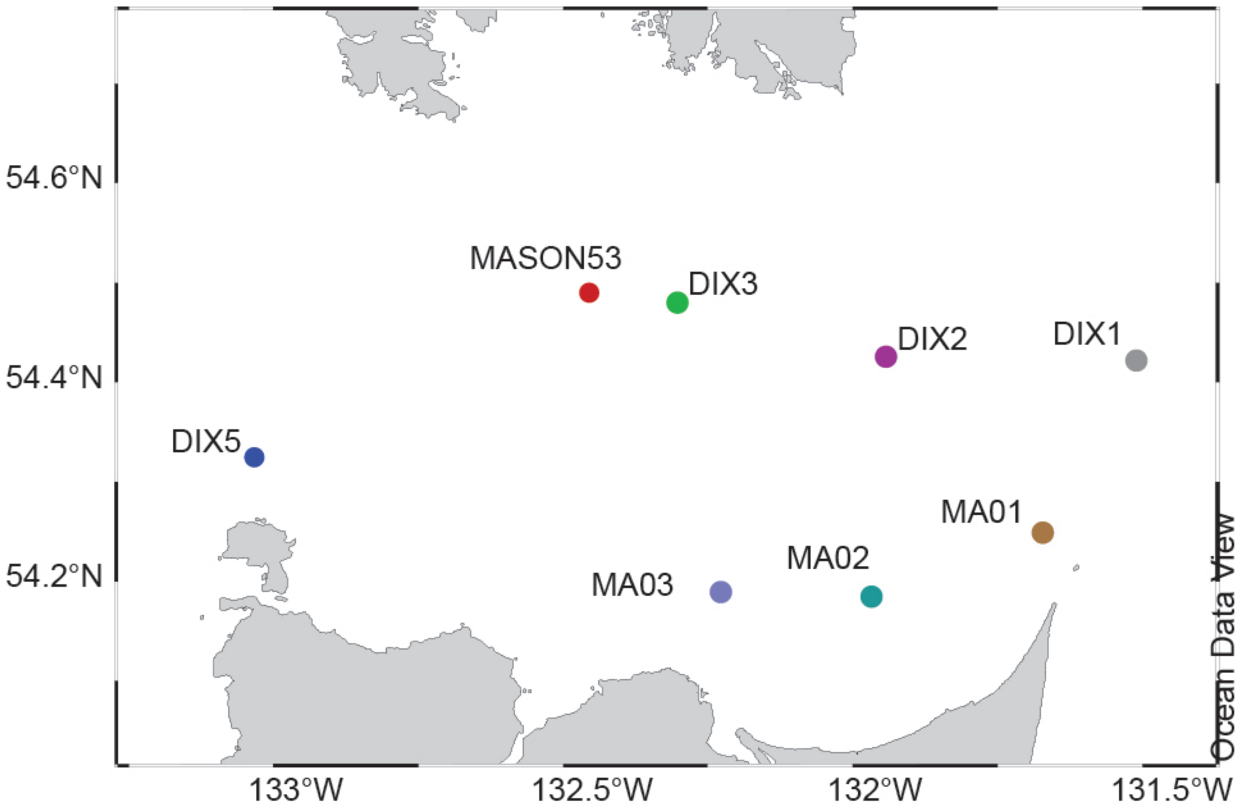

Figure 67. Dixon Entrance Region station map, 2020-069.

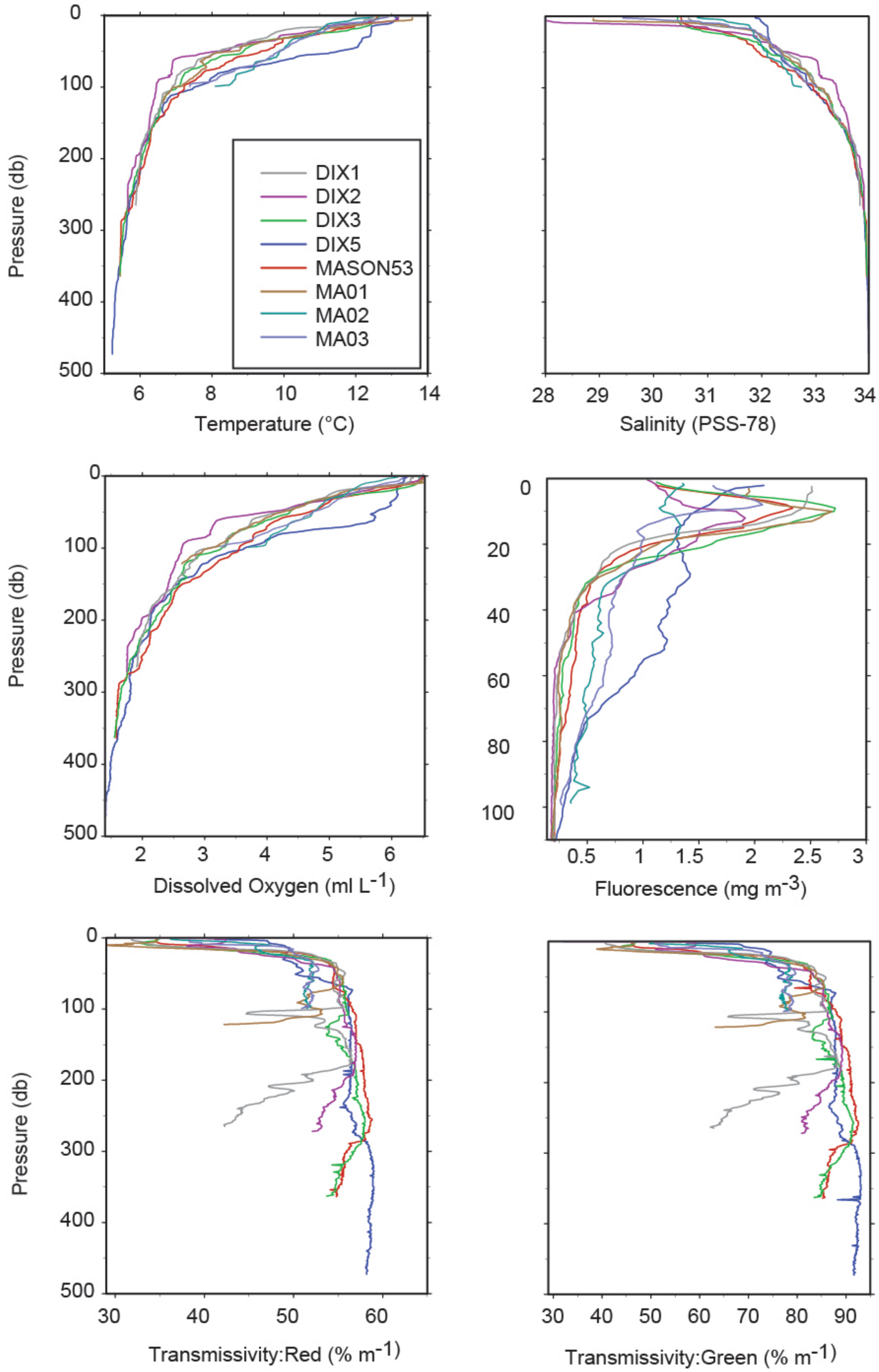

Figure 68. SBE911 data collected during 2020-069, Dixon Entrance Region.

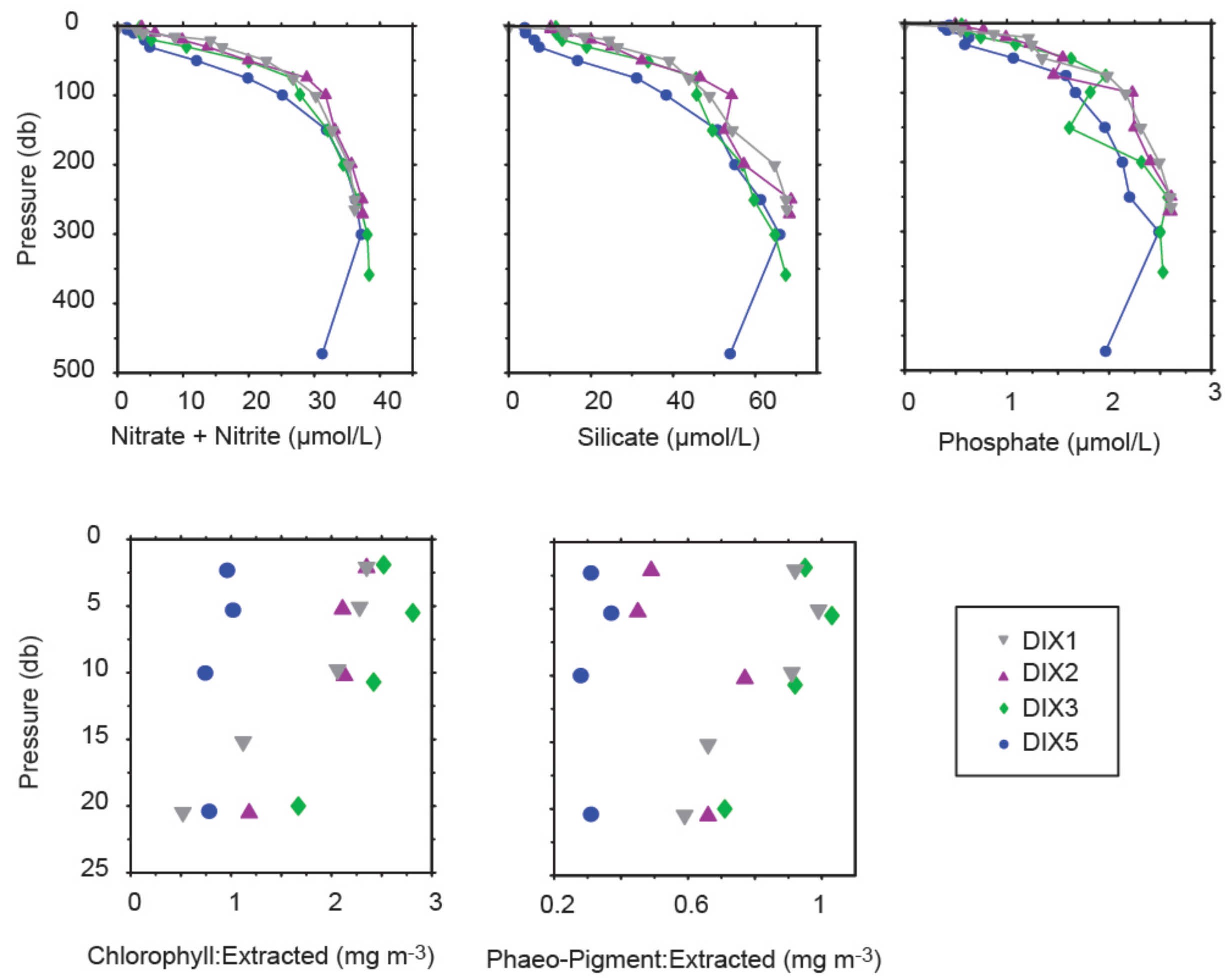

Figure 69. Niskin bottle data collected during 2020-069, Dixon Entrance Region.

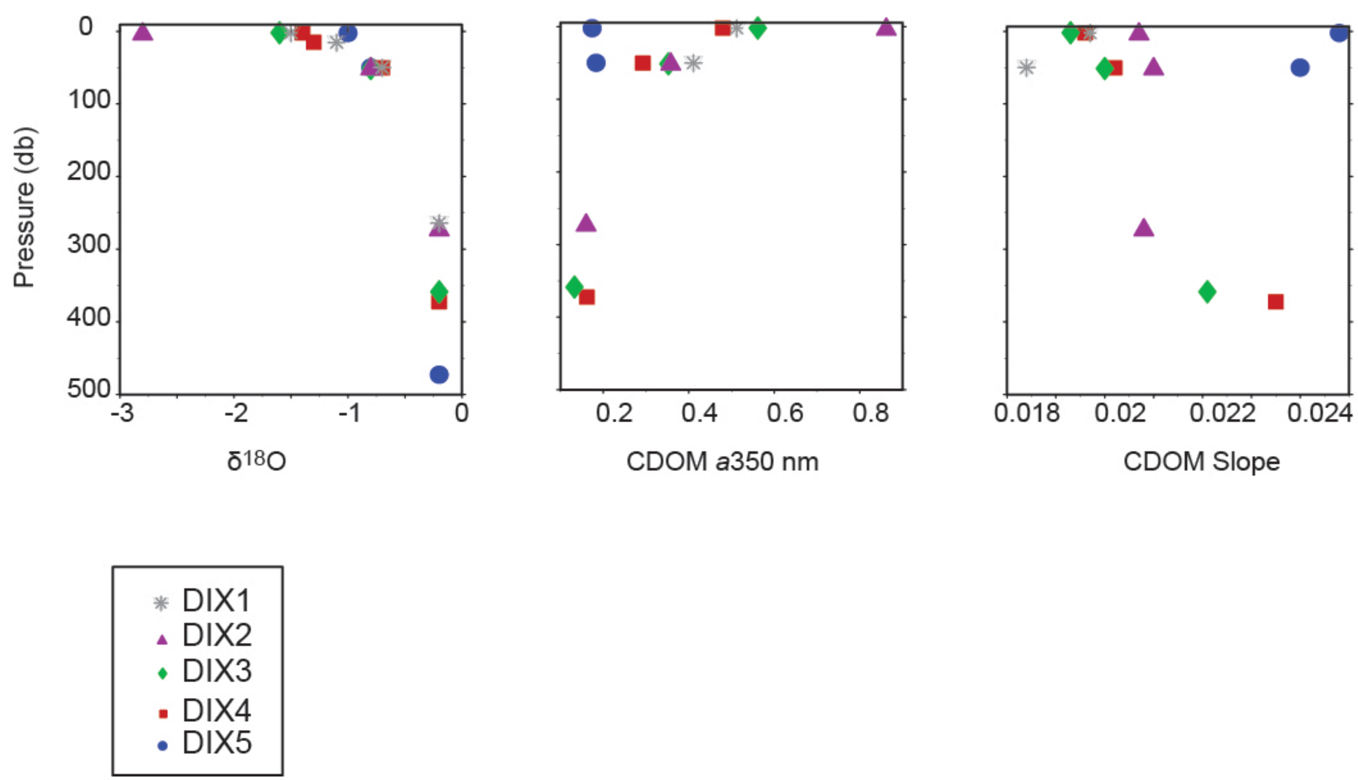

Figure 69 continued. Niskin bottle data collected during 2020-069, Dixon Entrance Region.

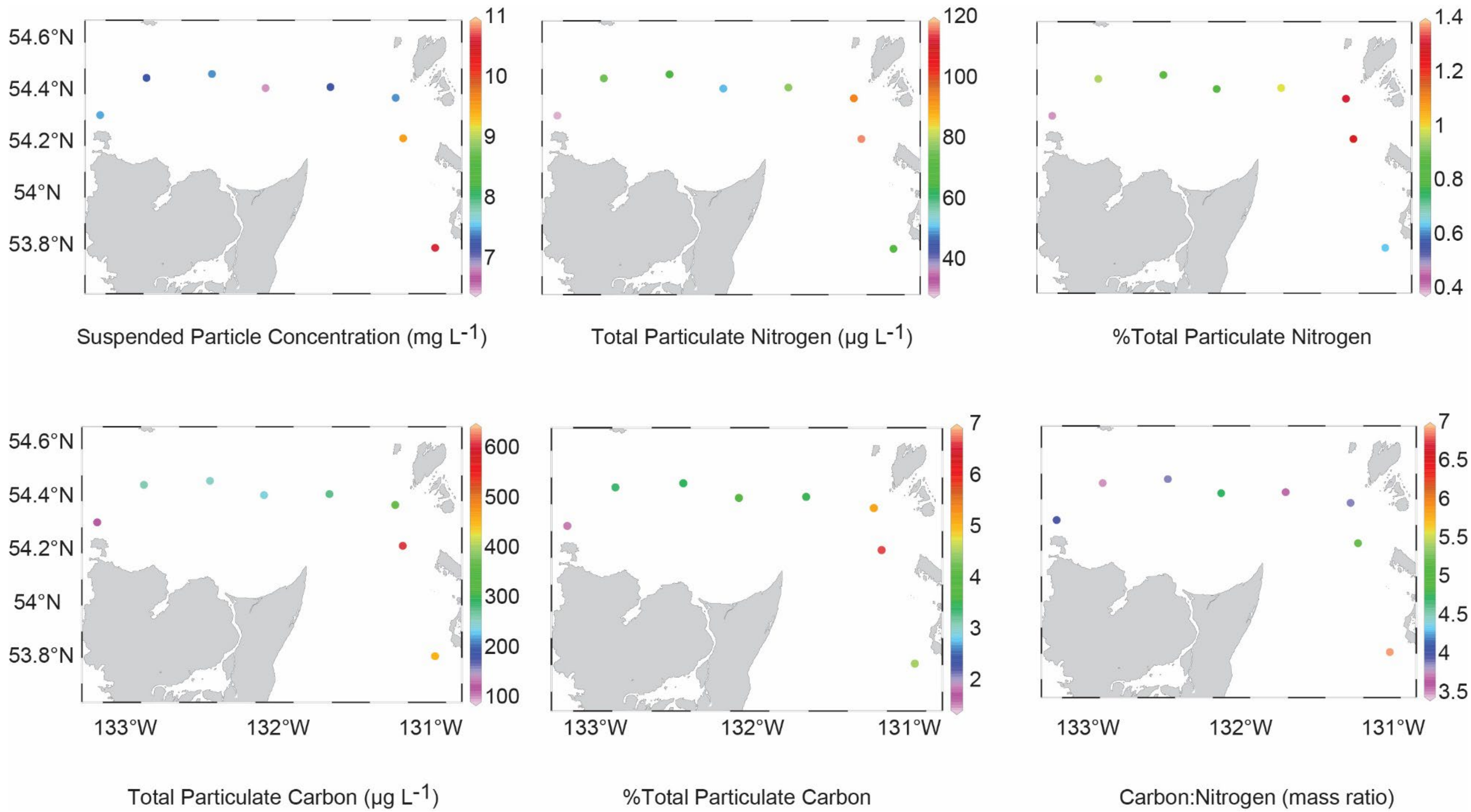

Figure 70. Results of the GFF suspended particulate matter analysis collected in 2020-069, surface niskin samples, Hecate Strait and Dixon Entrance Regions combined.

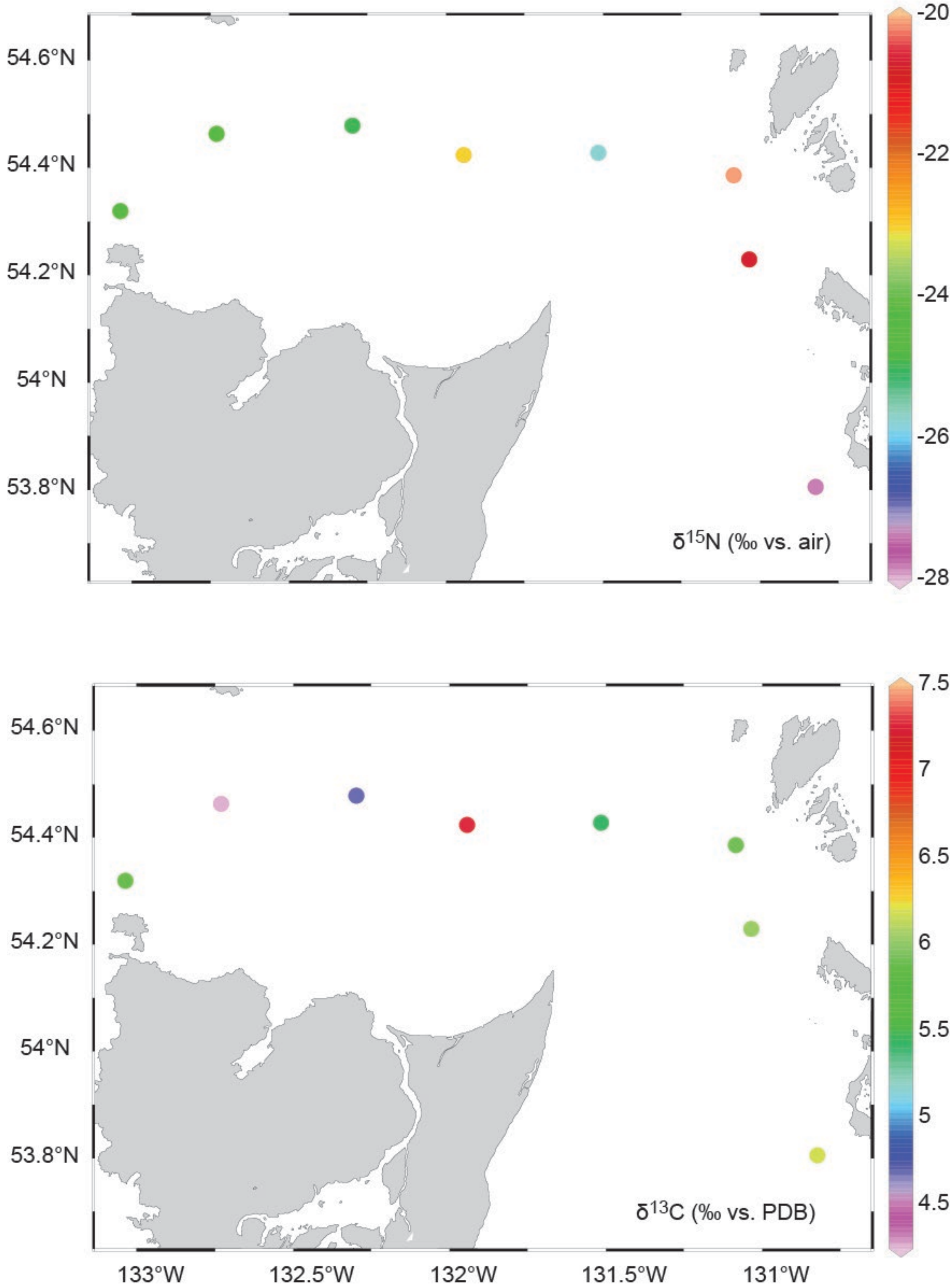

Figure 70 continued. Results of the GFF suspended particulate matter analysis collected in 2020-069, surface niskin samples, Hecate Strait and Dixon Entrance Regions combined.

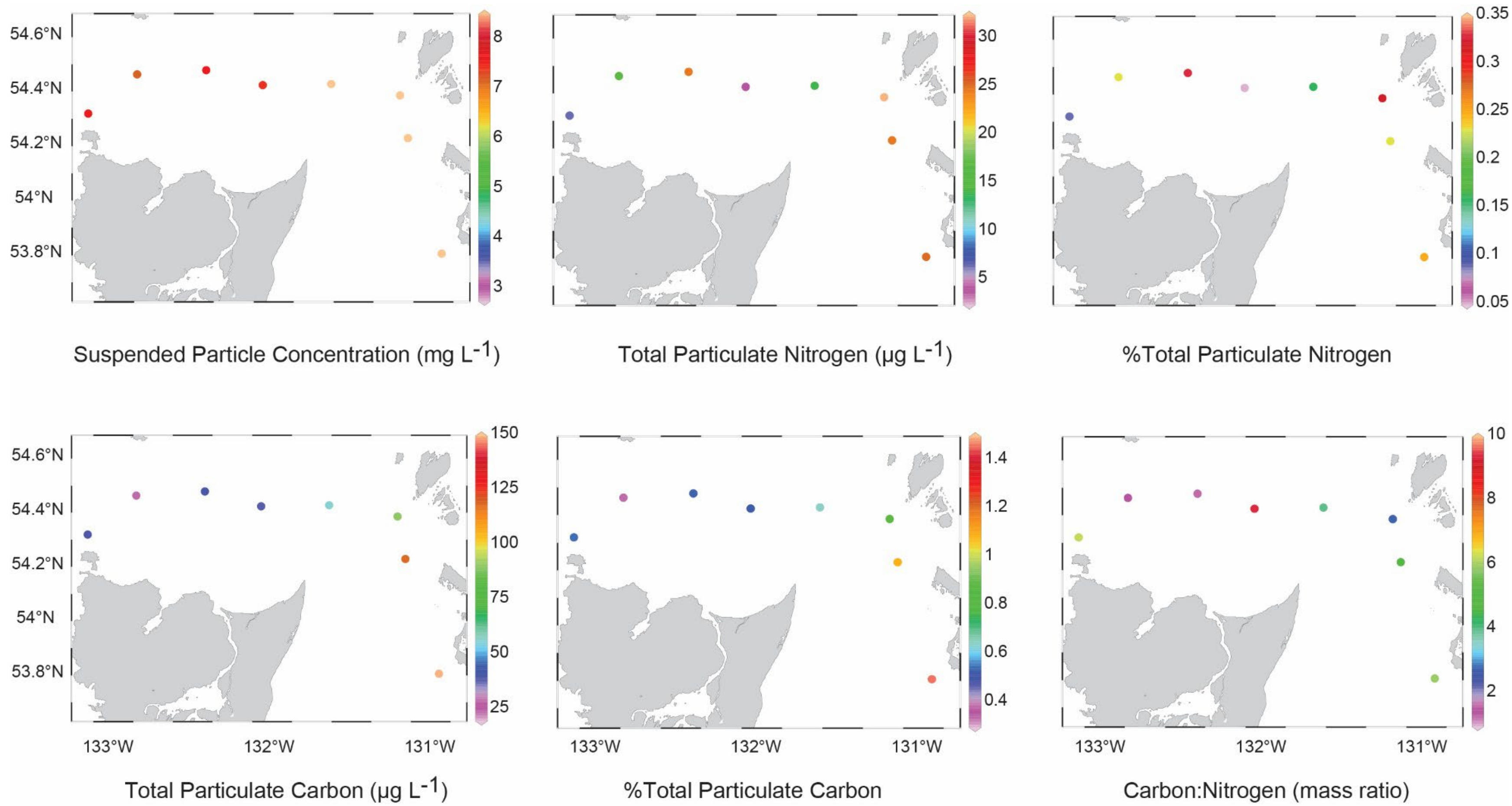

Figure 71. Results of the GFF suspended particulate matter analysis collected on 2020-069, bottom-5m niskin samples, Hecate Strait and Dixon Entrance Regions combined.

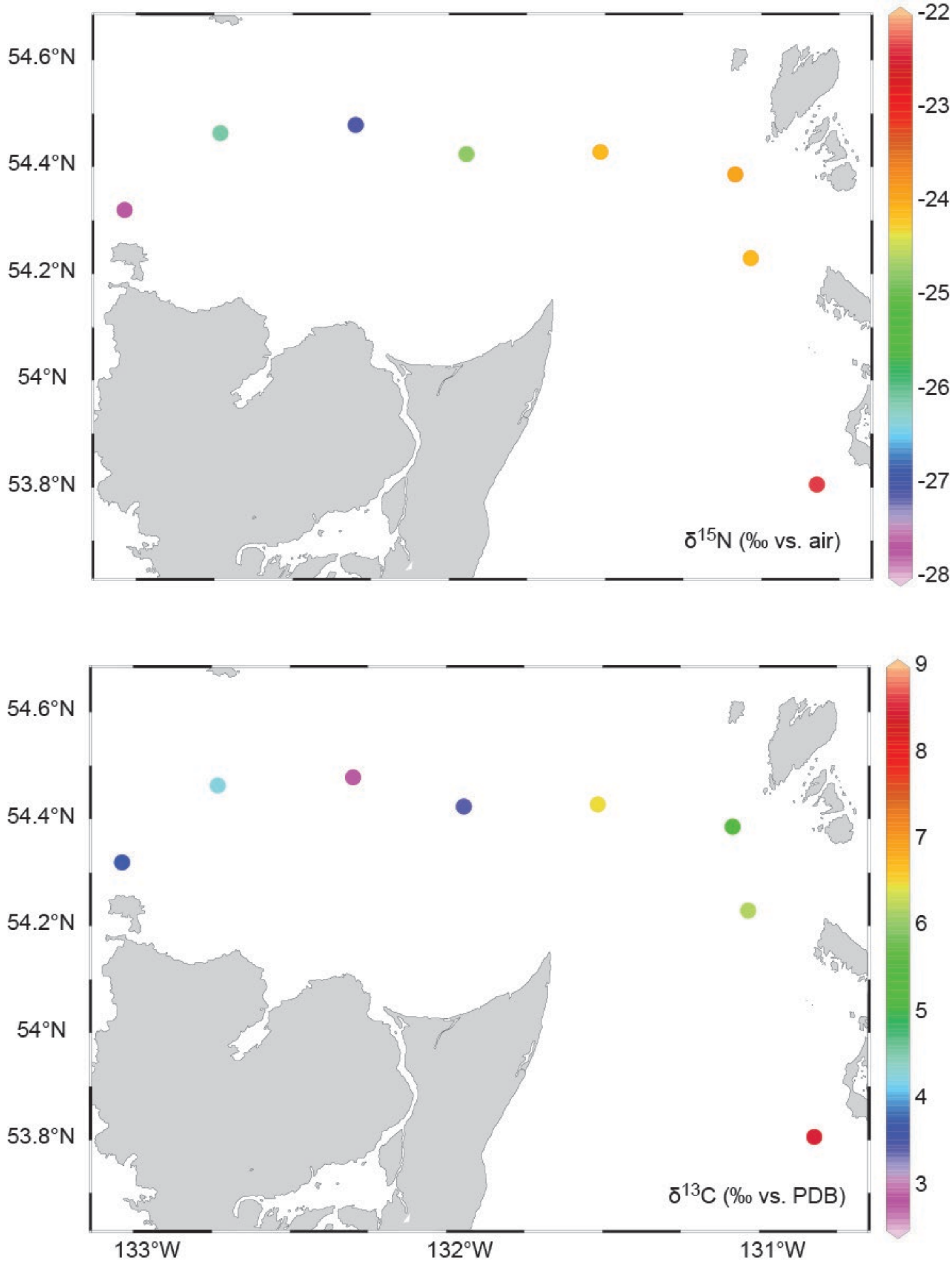

Figure 71 continued. Results of the GFF suspended particulate matter analysis collected on 2020-069, bottom-5m niskin samples, Hecate Strait and Dixon Entrance Regions combined.

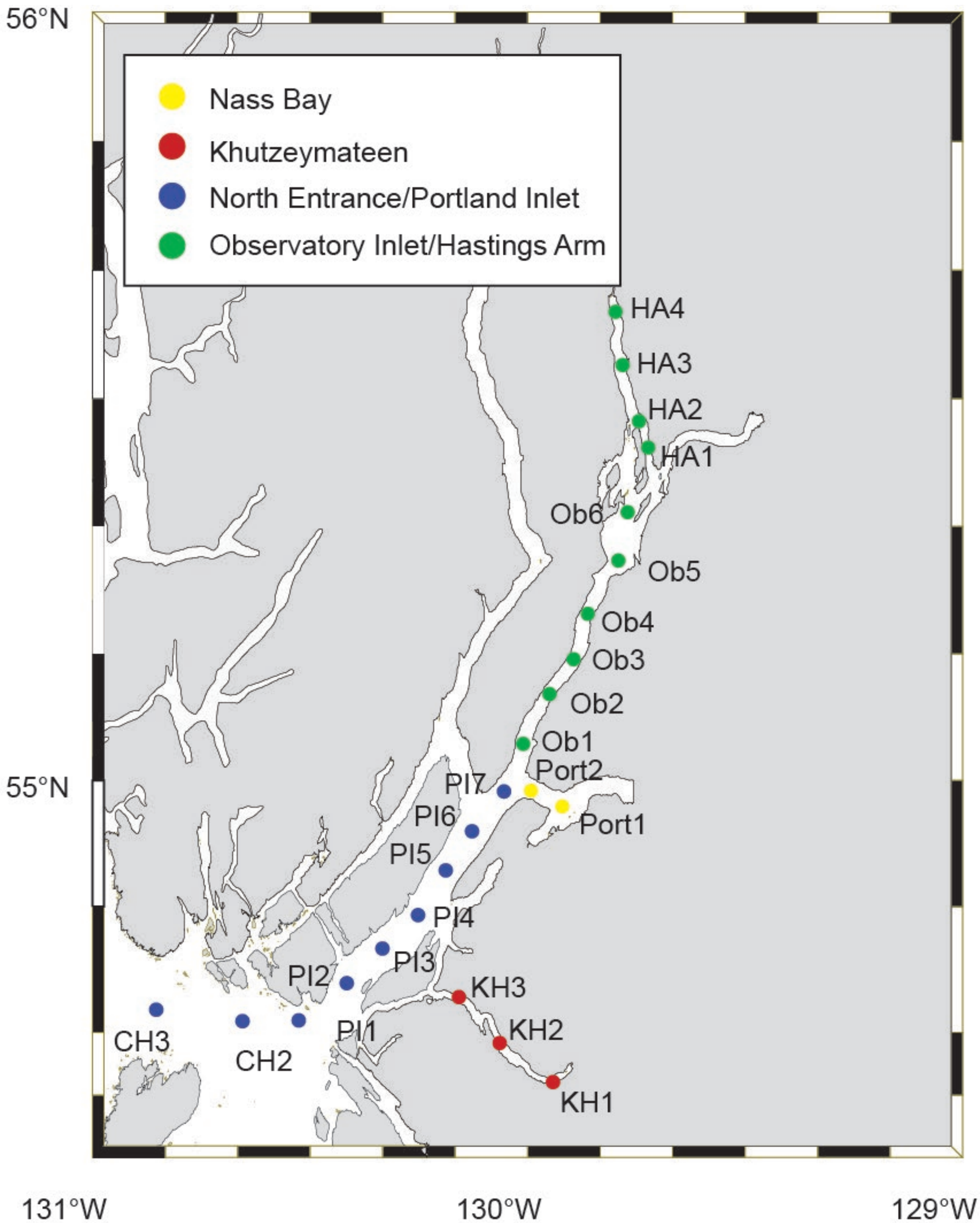

Figure 72. North Inlets Region station map, 2020-069.

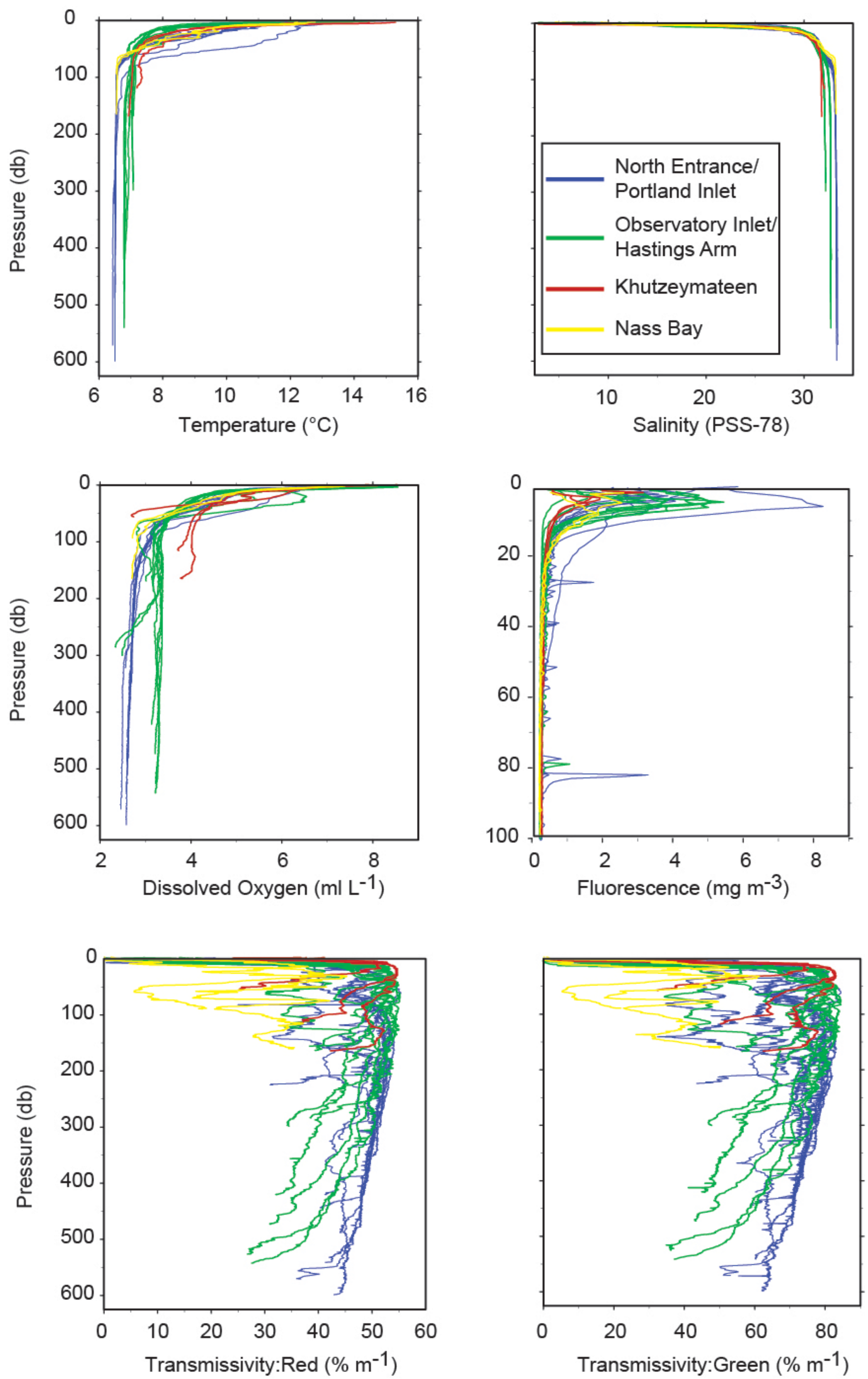

Figure 73. SBE911 data collected during 2020-069, Northern Inlet Region.

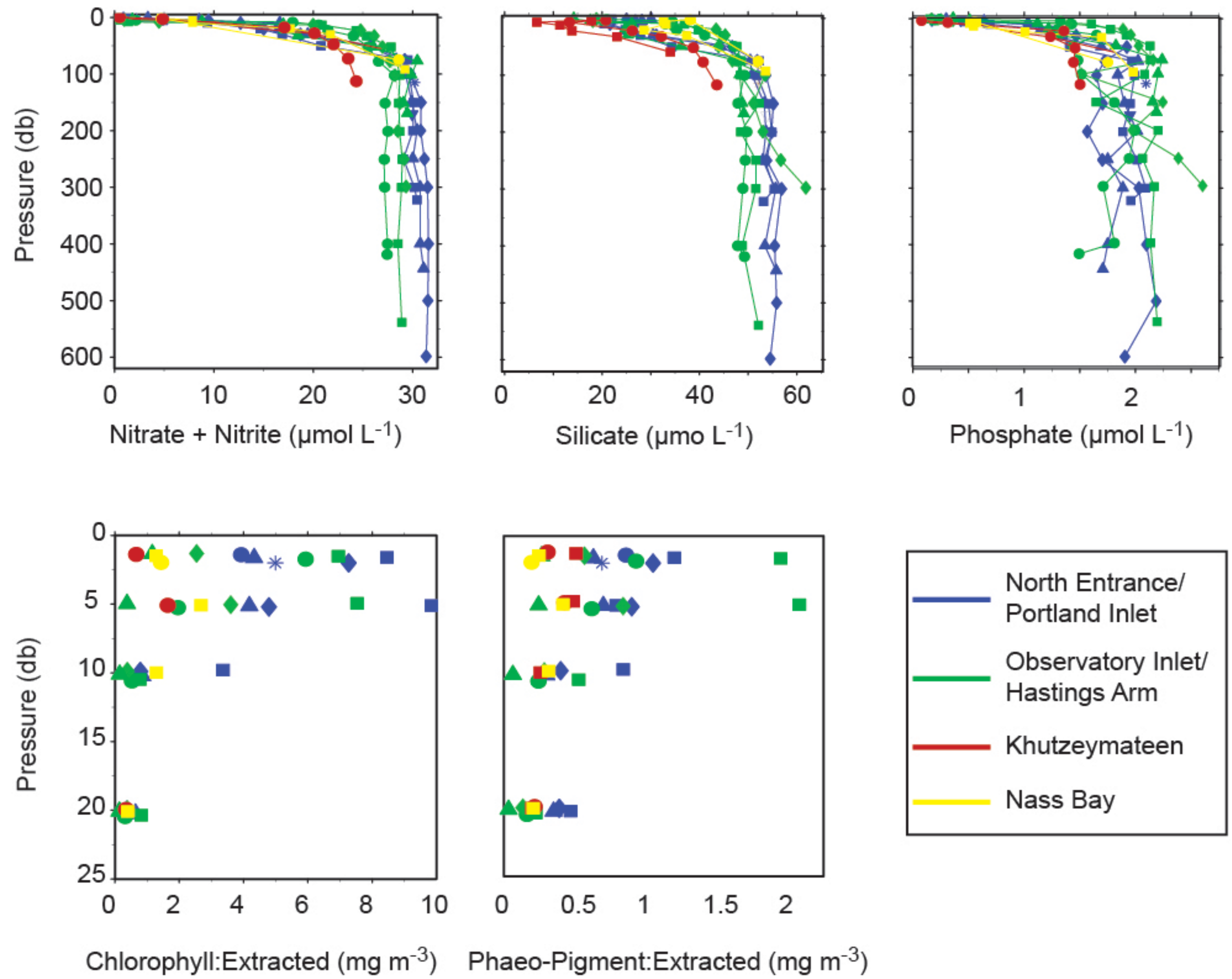

Figure 74.Niskin bottle data collected during 2020-069, North Inlets Region.

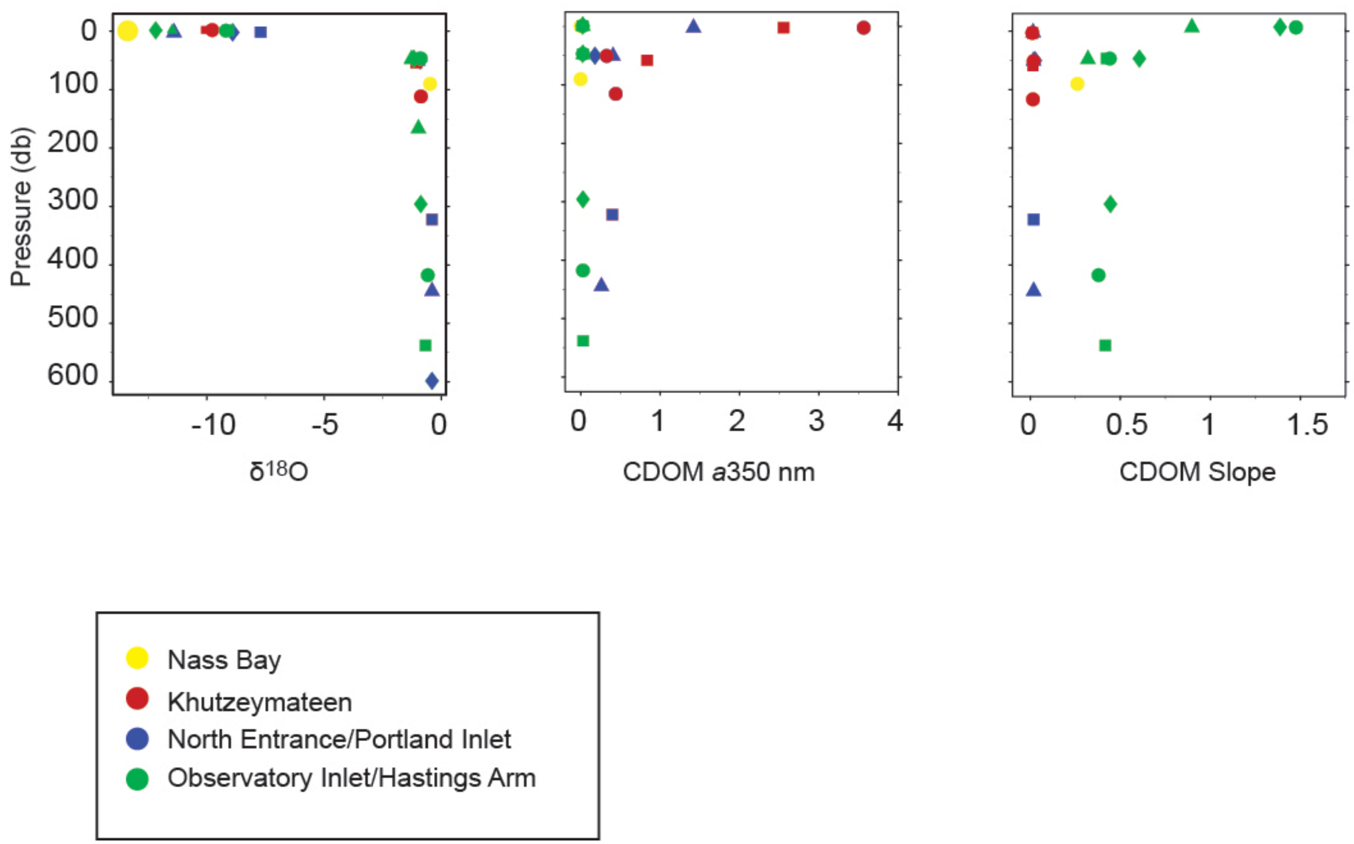

Figure 74 continued. Niskin bottle data collected during 2020-069, North Inlets Region.

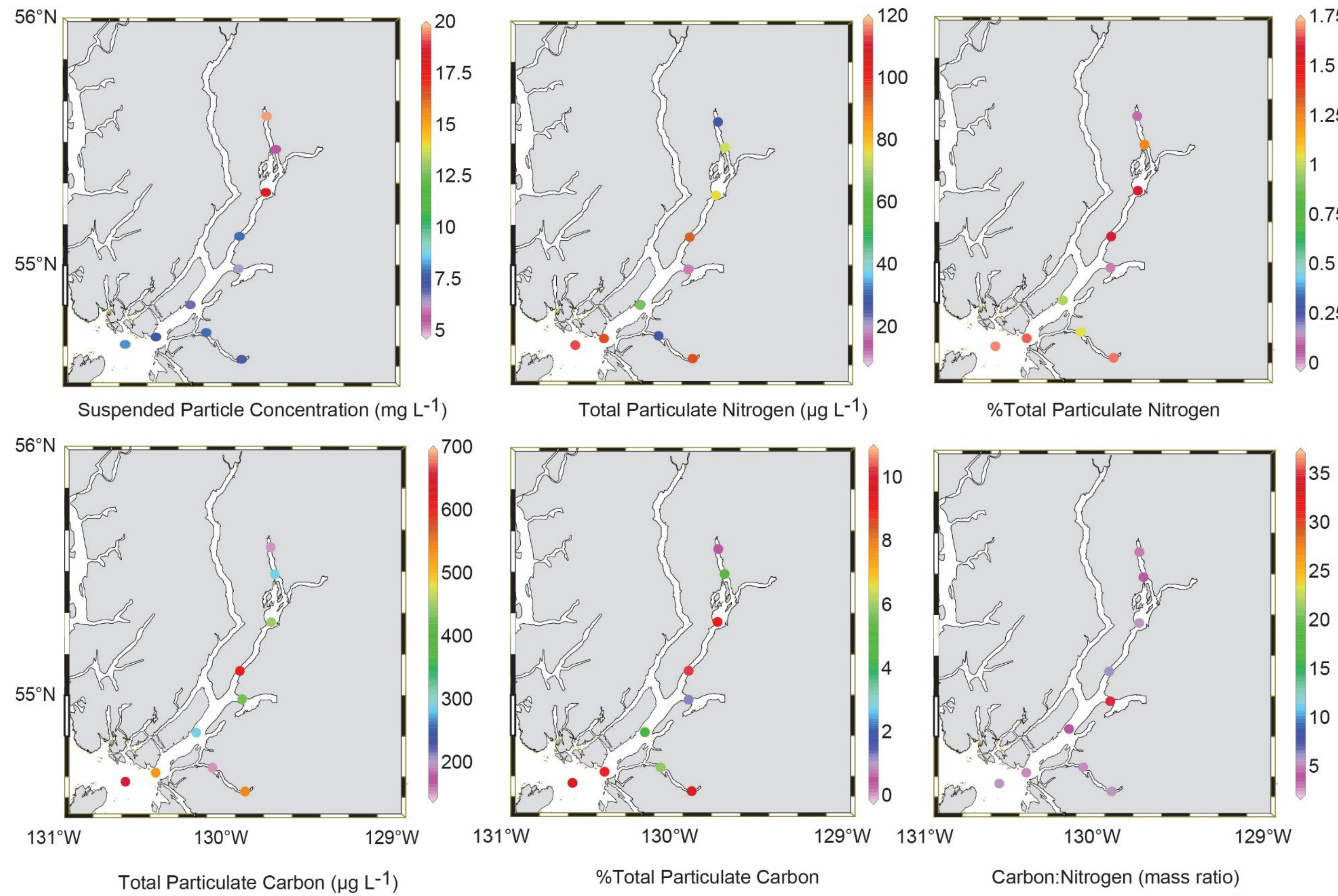

Figure 75. Results of the GFF suspended particulate matter analysis collected on 2020-069, surface niskin samples, Northern Inlet Region.

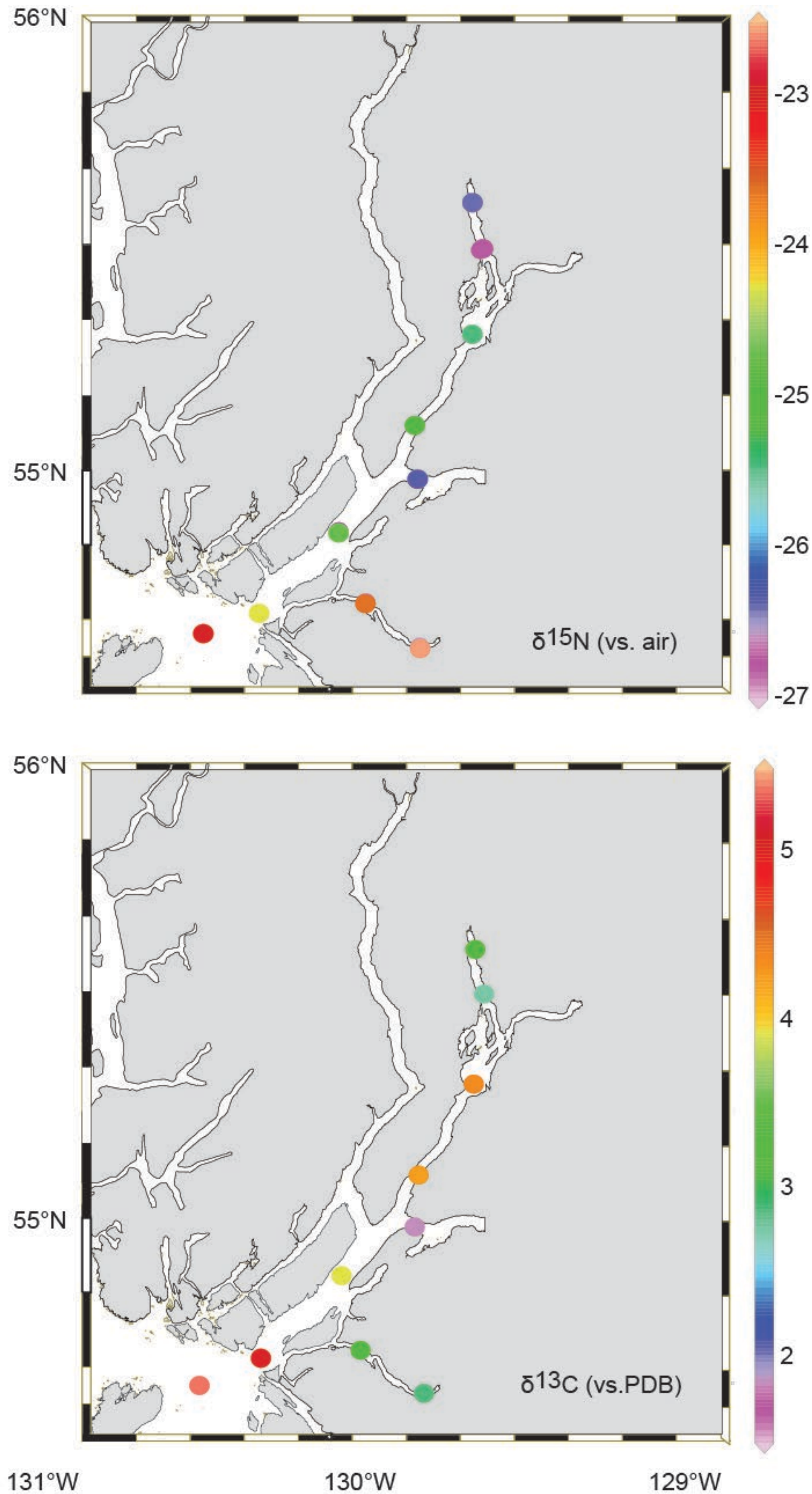

Figure 75 continued. Results of the GFF suspended particulate matter analysis collected on 2020-069, surface niskin samples, Northern Inlet Region.

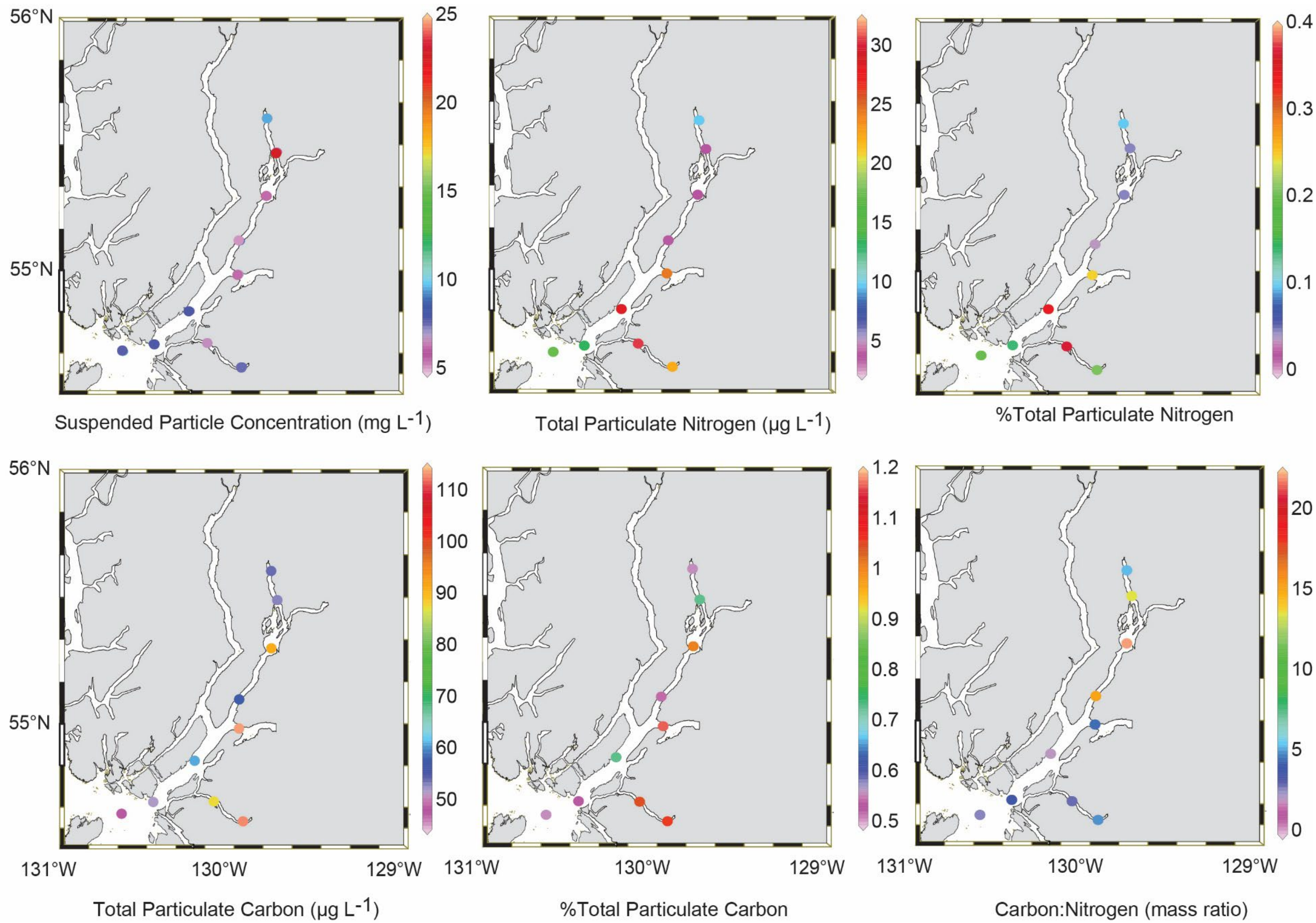

Figure 76. Results of the GFF suspended particulate matter analysis collected on 2020-069, bottom-5m niskin samples, Northern Inlet Region.

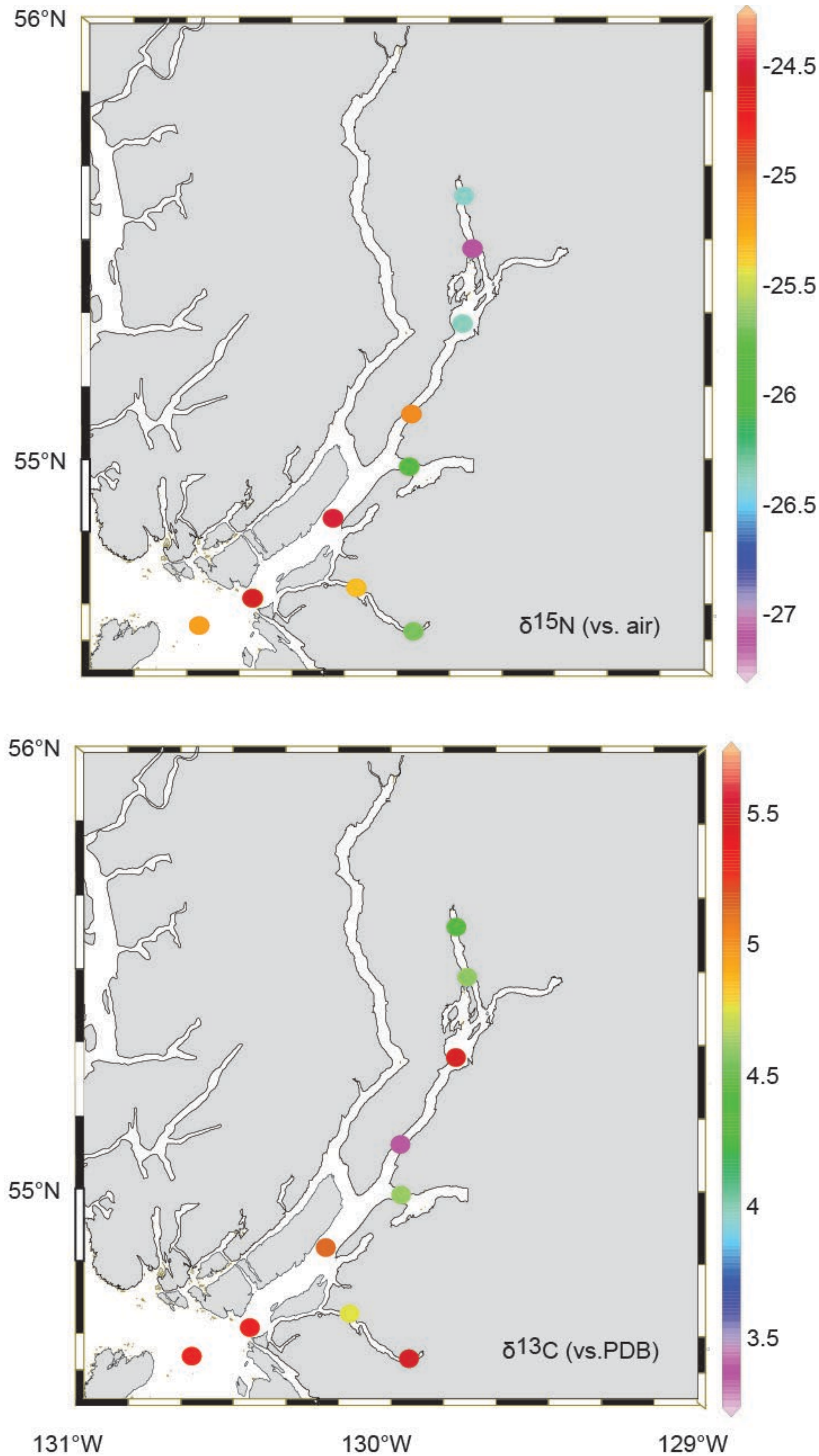

Figure 76 continued. Results of the GFF suspended particulate matter analysis collected on 2020-069, bottom-5m niskin samples, Northern Inlet Region.

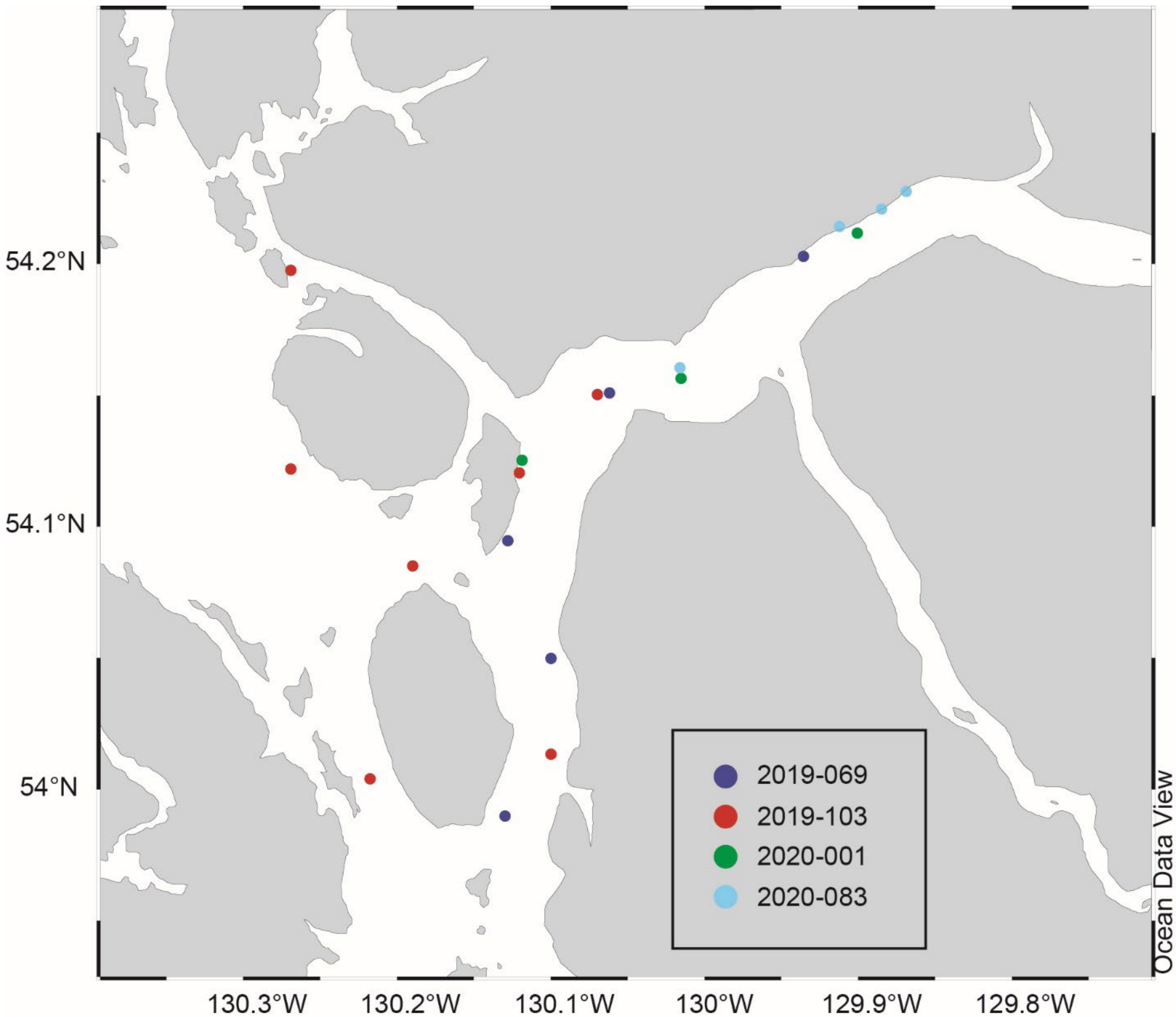

Figure 77. Skeena River sampling locations during 2019-069, 2019-103, 2020-001, and 2020-083.

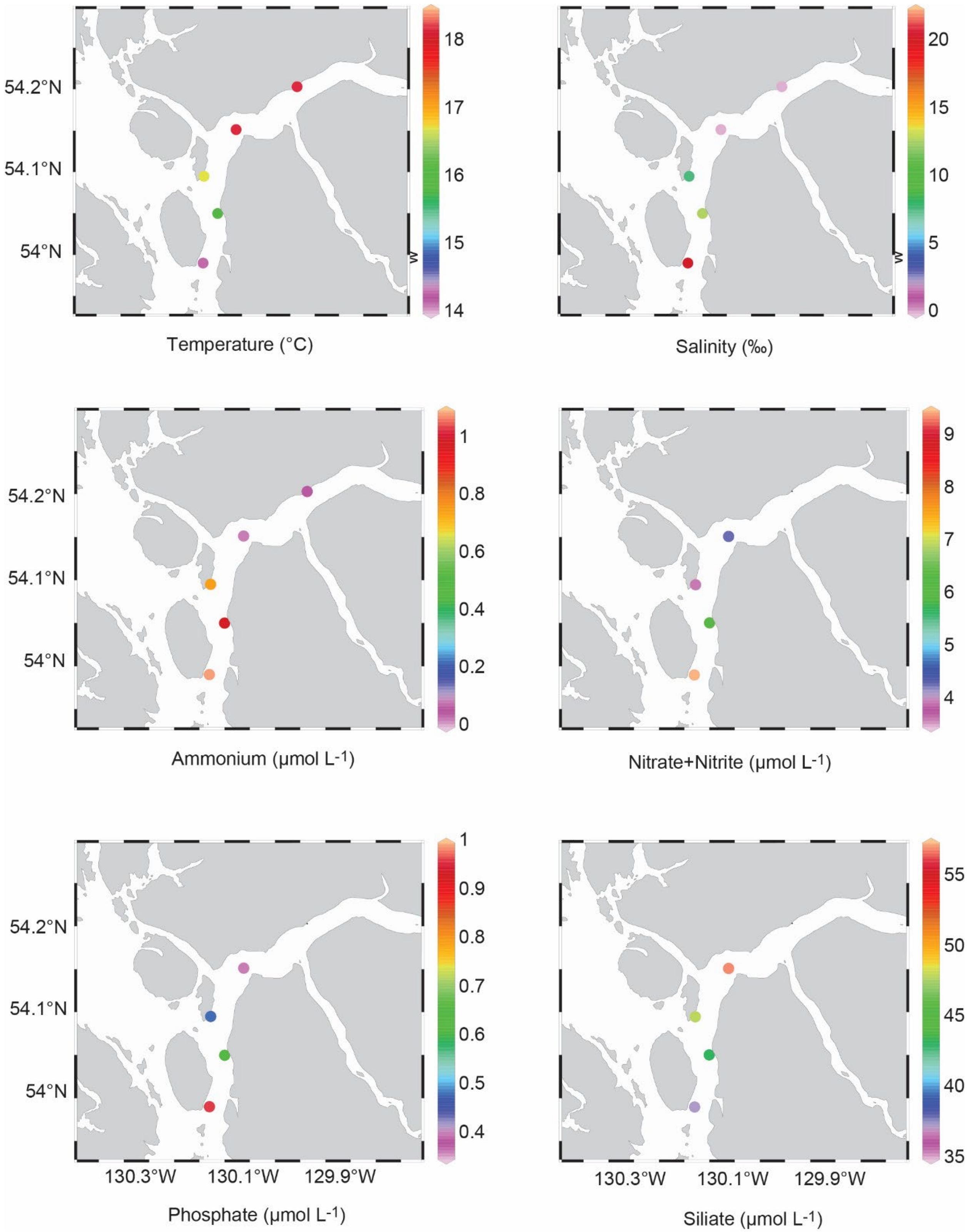

Figure 78. Water sample data collected during 2019-069.

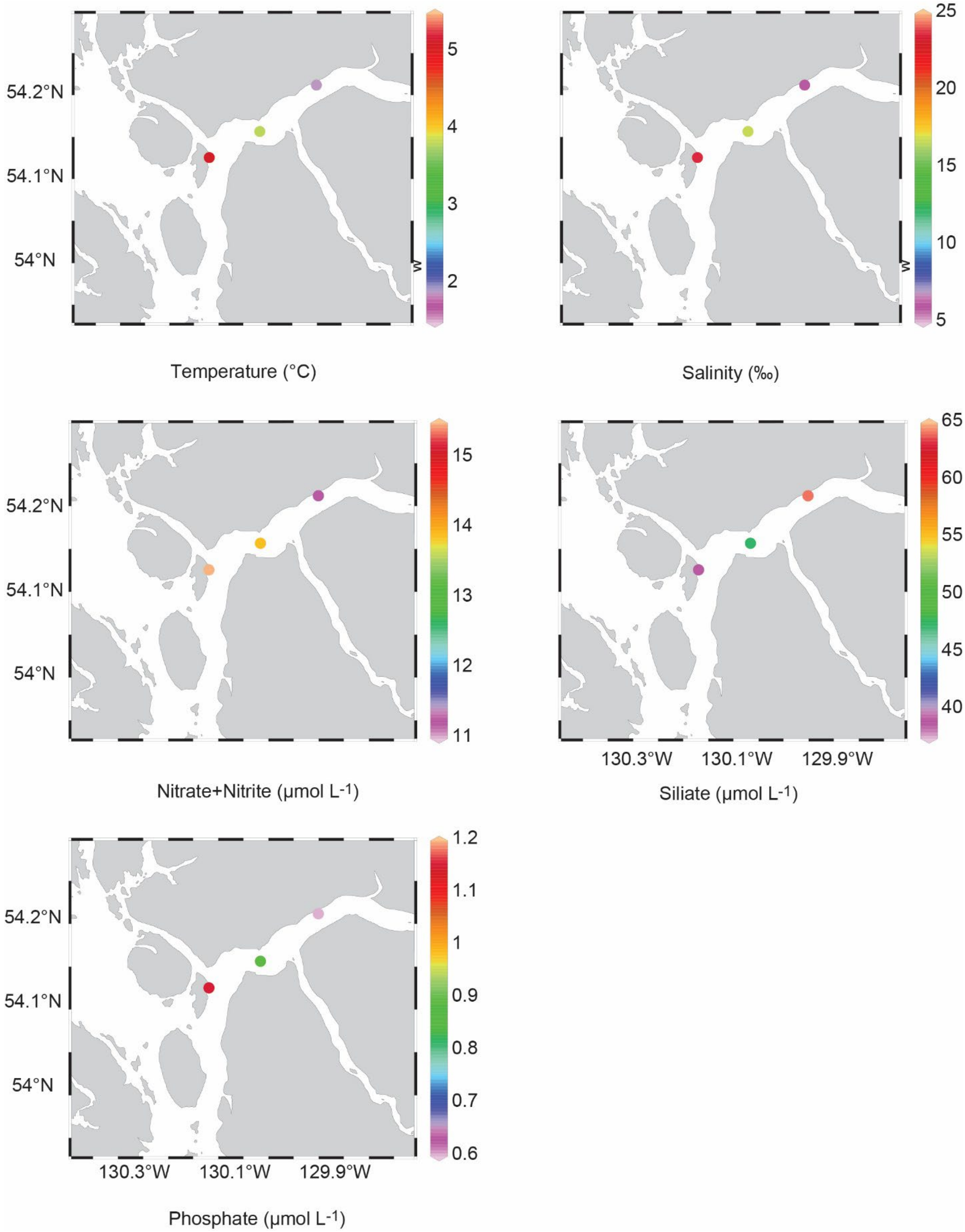

Figure 79. Water sample data collected during 2020-001.

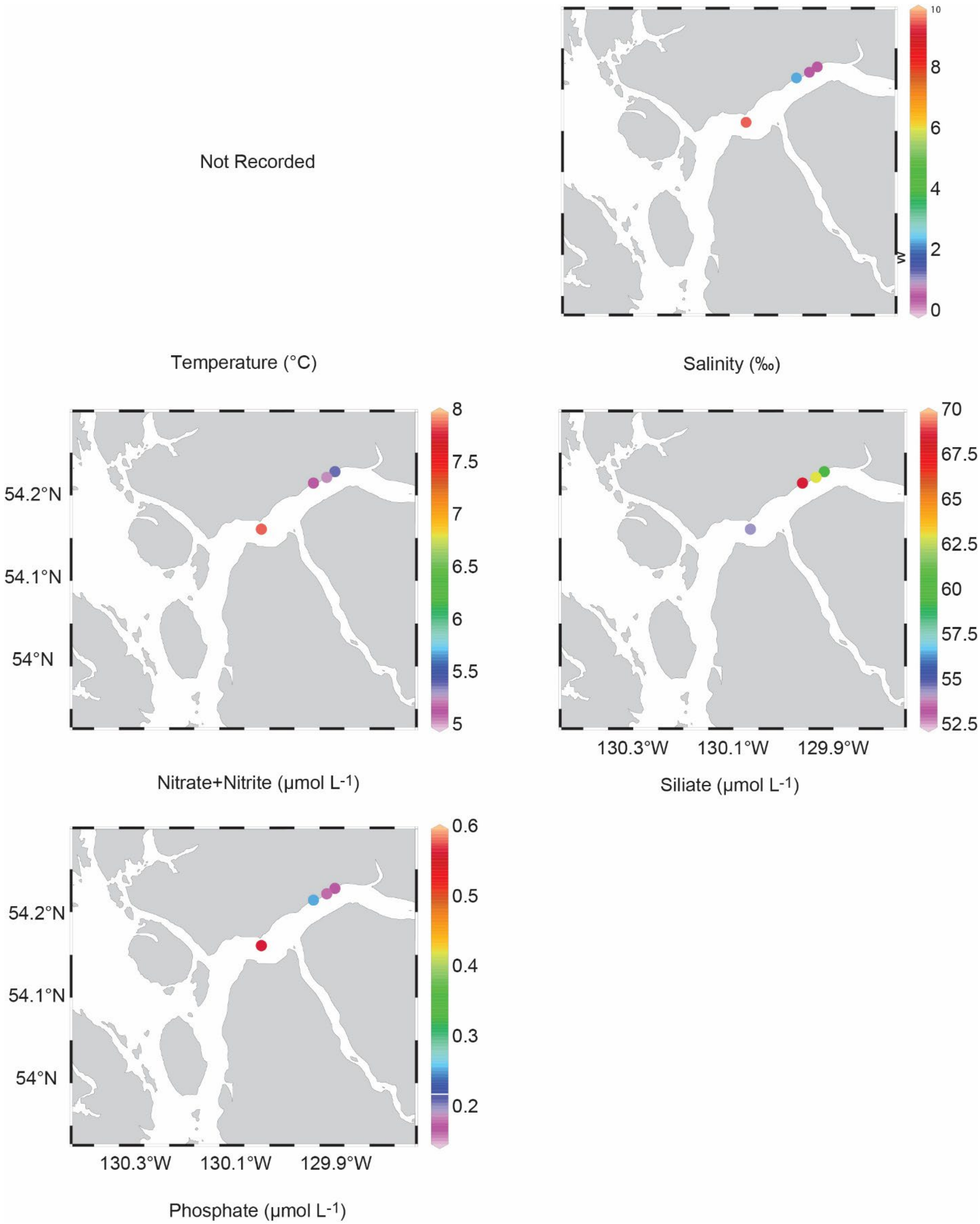

Figure 80. Water sample data collected during 2020-083.

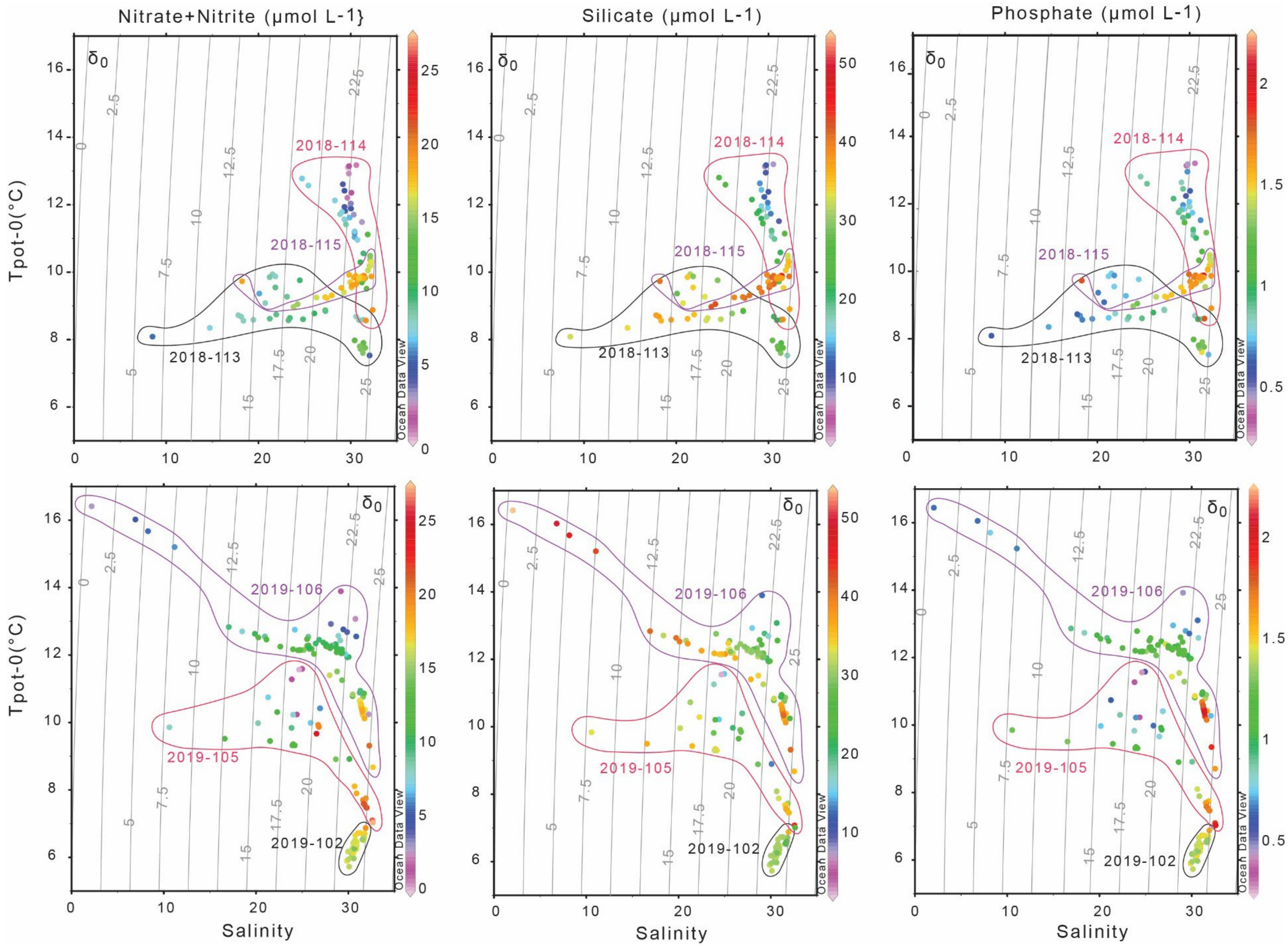

Figure 81. Skeena River nutrients in TS space from cruises 2018-113 (March), 2018-114 (August), 2018-115 (November), 2019-102 (March), 2019-105 (June), 2019-016 (August). See Figure 77 for station locations.

Table 1.210Pb and 226Ra analysis from cores taken in 2018-025.

Core Depth (cm)	Dry Wt./ Wet cc. (g/cm3) (33 ppt corrected)	% Loss on Drying	Mass in extrapolated section (g/cm2)	Cumulative Mass to Bottom of Current Section (g/cm2)	Plot-point of cumulative mass in current section (g/cm2)	Po-209 counts less detector back-ground	Po-210 Counts Less Detector Back-ground and Po-209 Spike Standard Blank	Weight of Sample Counted-Salt (g)	Count Time (sec)	Po-210 Total Activity (DPM/g) (salt corrected)	Error Po 210 +/- 1 S.D. (DPM/g)	Ra-226 Activity (DPM/g dry wt.)	Error Ra-226 +/- 1 S.D. (DPM/g dry wt.)
Chat28													
0-1	1.105	34.45%	1.105	1.105	0.552	1945	450	0.479	60000	4.75	0.23		
1-2	0.718	49.48%	0.718	1.823	1.464	2024	611	0.546	60000	5.43	0.22		
2-3	0.823	44.92%	0.823	2.646	2.234	2072	670	0.495	60000	6.42	0.25		
3-4	0.826	44.62%	0.826	3.472	3.059	1972	636	0.483	60000	6.56	0.26	0.63	0.04
4-5	0.854	43.62%	0.854	4.326	3.899	2003	697	0.557	60000	6.14	0.24		
5-6	1.131	33.43%	1.131	5.458	4.892	1632	605	0.535	60000	6.81	0.28		
6-7	1.106	34.30%	1.106	6.564	6.011	1810	608	0.526	60000	6.28	0.26		
7-8	0.953	39.48%	0.953	7.516	7.040	1602	477	0.521	60000	5.61	0.26		
8-9	0.963	39.43%	0.963	8.479	7.998	1979	522	0.503	60000	5.16	0.23		
9-10	0.973	39.01%	0.973	9.452	8.966					5.30	0.24		
10-12	0.960	39.39%	1.921	11.373	10.412	1936	502	0.504	60000	5.06	0.23		
12-14	1.004	37.90%	2.008	13.381	12.377	1724	447	0.493	60000	5.17	0.25	0.59	0.04
14-16	0.985	38.47%	1.970	15.350	14.365	1869	480	0.488	60000	5.16	0.24		
16-18	0.975	38.54%	1.951	17.301	16.326	2012	498	0.480	60000	5.07	0.23		
18-20	0.977	38.74%	1.955	19.256	18.279	1957	510	0.494	60000	5.19	0.23		
20-25	0.953	39.76%	4.763	24.019	21.637	2100	552	0.517	60000	5.00	0.22		
25-30	0.928	40.31%	4.641	28.660	26.339	2005	495	0.507	60000	4.79	0.22		
30-35	0.956	39.32%	4.780	33.440	31.050	2055	414	0.481	60000	4.12	0.21		
35-40	0.937	40.43%	4.687	38.127	35.783	1993	280	0.507	60000	2.73	0.17	0.60	0.04

Table 1.210Pb and 226Ra analysis from cores taken in 2018-025.

Core Depth (cm)	Dry Wt./ Wet cc. (g/cm3) (33 ppt corrected)	% Loss on Drying	Mass in extrapolated section (g/cm2)	Cumulative Mass to Bottom of Current Section (g/cm2)	Plot-point of cumulative mass in current section (g/cm2)	Po-209 counts less detector back-ground	Po-210 Counts Less Detector Back-ground and Po-209 Spike Standard Blank	Weight of Sample Counted-Salt (g)	Count Time (sec)	Po-210 Total Activity (DPM/g) (salt corrected)	Error Po-210 +/- 1 S.D. (DPM/g)	Ra-226 Activity (DPM/g dry wt.)	Error Ra-226 +/- 1 S.D. (DPM/g dry wt.)
CH8													
0-1	0.331	70.54%	0.331	0.331	0.166	2552	2001	0.446	60000	**16.87**	0.38		
1-2	0.414	65.36%	0.414	0.745	0.538	2414	1924	0.497	60000	**15.37**	0.35		
2-3	0.440	63.82%	0.440	1.186	0.965	2582	1727	0.451	60000	**14.23**	0.34		
3-4	0.440	63.69%	0.440	1.626	1.406	2466	1589	0.459	60000	**13.48**	0.34		
4-5	0.464	62.35%	0.464	2.089	1.858	2359	1652	0.459	60000	**14.63**	0.36		
5-6	0.481	61.36%	0.481	2.571	2.330	2837	1824	0.464	60000	**13.29**	0.31	0.47	0.04
6-7	0.494	60.60%	0.494	3.065	2.818					**13.39**	0.32		
7-8	0.509	59.81%	0.509	3.575	3.320	2578	1645	0.474	60000	**12.90**	0.32		
8-9	0.519	59.27%	0.519	4.093	3.834	2635	1670	0.466	60000	**13.04**	0.32		
9-10	0.539	58.04%	0.539	4.633	4.363	1537	912	0.461	60000	**12.35**	0.41		
10-12	0.527	58.68%	1.054	5.687	5.160	2232	1418	0.475	60000	**12.84**	0.34		
12-14	0.594	55.31%	1.188	6.875	6.281	2568	866	0.526	60000	**6.16**	0.21		
14-16	0.594	55.26%	1.187	8.062	7.469	2169	299	0.470	60000	**2.81**	0.16	0.46	0.04
16-18	0.653	52.56%	1.306	9.368	8.715	2210	105	0.507	60000	**0.90**	0.09		
18-20	0.657	52.21%	1.314	10.683	10.026	2173	74	0.489	60000	**0.67**	0.08		
20-25	0.717	49.36%	3.587	14.270	12.476	2417	68	0.490	60000	**0.55**	0.07		
25-30	0.716	49.40%	3.579	17.849	16.059	2212	60	0.510	60000	**0.51**	0.07		
30-35	0.706	49.50%	3.528	21.377	19.613	2196	69	0.489	60000	**0.62**	0.08		
35-40	0.732	48.56%	3.661	25.038	23.208	2684	79	0.503	60000	**0.56**	0.07	0.50	0.04

Table 1.210Pb and 226Ra analysis from cores taken in 2018-025.

Core Depth (cm)	Dry Wt./ Wet cc. (g/cm3) (33 ppt corrected)	% Loss on Drying	Mass in extrapolated section (g/cm2)	Cumulative Mass to Bottom of Current Section (g/cm2)	Plot-point of cumulative mass in current section (g/cm2)	Po-209 counts less detector back-ground	Po-210 Counts Less Detector Back-ground and Po-209 Spike Standard Blank	Weight of Sample Counted-Salt (g)	Count Time (sec)	Po-210 Total Activity (DPM/g) (salt corrected)	Error Po-210 +/- 1 S.D. (DPM/g)	Ra-226 Activity (DPM/g dry wt.)	Error Ra-226 +/- 1 S.D. (DPM/g dry wt.)
Chat1													
0-1	0.495	60.70%	0.495	0.495	0.247	1552	949	0.554	60000	**10.66**	0.35		
1-2	0.557	57.25%	0.557	1.052	0.773	2319	1214	0.463	60000	**10.90**	0.31		
2-3	0.543	57.97%	0.543	1.594	1.323	1968	1155	0.525	60000	**10.80**	0.32		
3-4	0.550	57.65%	0.550	2.144	1.869	2139	1237	0.516	60000	**10.83**	0.32		
4-5	0.555	57.27%	0.555	2.699	2.421	2247	1214	0.488	60000	**10.70**	0.31	0.58	0.04
5-6	0.647	52.54%	0.647	3.346	3.022	1989	1013	0.500	60000	**9.84**	0.31		
6-7	0.580	55.90%	0.580	3.926	3.636	1977	1029	0.465	60000	**10.82**	0.34		
7-8	0.594	55.31%	0.594	4.520	4.223	1920	952	0.471	60000	**10.17**	0.33		
8-9	0.603	54.79%	0.603	5.123	4.821	1969	1025	0.481	60000	**10.45**	0.33		
9-10	0.640	52.91%	0.640	5.763	5.443	2097	829	0.470	60000	**8.12**	0.28		
10-12	0.655	52.26%	1.309	7.072	6.418	1994	1023	0.491	60000	**10.10**	0.32		
12-14	0.687	50.67%	1.375	8.447	7.760					**6.21**	0.23		
14-16	0.707	49.75%	1.413	9.860	9.154	2008	430	0.487	60000	**4.25**	0.21	0.57	0.04
16-18	0.742	48.08%	1.484	11.344	10.602	2020	324	0.496	60000	**3.13**	0.18		
18-20	0.756	47.55%	1.511	12.856	12.100	1795	199	0.492	60000	**2.18**	0.15		
20-25	0.792	45.86%	3.959	16.815	14.835	2077	295	0.502	60000	**2.73**	0.16		
25-30	0.817	44.78%	4.083	20.898	18.856	2315	258	0.510	60000	**2.11**	0.15	0.57	0.04
30-35	0.830	44.25%	2.489	23.387	22.142	2296	404	0.496	60000	**3.43**	0.17		

Table 1.210Pb and 226Ra analysis from cores taken in 2018-025.

Core Depth (cm)	Dry Wt./ Wet cc. (g/cm3) (33 ppt corrected)	% Loss on Drying	Mass in extrapolated section (g/cm2)	Cumulative Mass to Bottom of Current Section (g/cm2)	Plot-point of cumulative mass in current section (g/cm2)	Po-209 counts less detector back-ground	Po-210 Counts Less Detector Back-ground and Po-209 Spike Standard Blank	Weight of Sample Counted-Salt (g)	Count Time (sec)	Po-210 Total Activity (DPM/g) (salt corrected)	Error Po 210 +/- 1 S.D. (DPM/g)	Ra-226 Activity (DPM/g dry wt.)	Error Ra-226 +/- 1 S.D. (DPM/g dry wt.)
Chat2													
0-1	0.446	63.36%	0.446	0.446	0.223	2292	1876	0.489	60000	**16.13**	0.37		
1-2	0.492	60.75%	0.492	0.938	0.692	2235	1852	0.471	60000	**16.97**	0.39		
2-3	0.522	59.04%	0.522	1.461	1.199	2558	2423	0.547	60000	**16.70**	0.35		
3-4	0.548	57.66%	0.548	2.009	1.735					**17.00**	0.38		
4-5	0.552	57.51%	0.552	2.561	2.285	1941	1680	0.489	60000	**17.06**	0.42	0.63	0.04
5-6	0.572	56.34%	0.572	3.133	2.847	2557	2191	0.507	60000	**16.31**	0.35		
6-7	0.599	54.97%	0.599	3.733	3.433	2161	1738	0.469	60000	**16.55**	0.40		
7-8	0.614	54.21%	0.614	4.347	4.040	2509	1900	0.480	60000	**15.22**	0.35		
8-9	0.624	53.84%	0.624	4.970	4.658	2221	1786	0.478	60000	**16.22**	0.38		
9-10	0.629	53.60%	0.629	5.599	5.285	2708	2042	0.471	60000	**15.45**	0.34		
10-12	0.641	52.90%	1.282	6.882	6.240	2315	1649	0.483	60000	**14.23**	0.35		
12-14	0.671	51.35%	1.341	8.223	7.552	2016	1462	0.504	60000	**13.87**	0.36		
14-16	0.675	51.29%	1.350	9.573	8.898	2199	1346	0.482	60000	**12.24**	0.33	0.39	0.04
16-18	0.672	51.40%	1.344	10.917	10.245	2386	1174	0.492	60000	**9.65**	0.28		
18-20	0.673	51.39%	1.346	12.263	11.590	2277	1216	0.489	60000	**10.54**	0.30		
20-25	0.718	49.19%	3.591	15.854	14.059	2538	1084	0.477	60000	**8.64**	0.27		
25-30	0.755	47.57%	3.774	19.628	17.741	2665	558	0.483	60000	**4.18**	0.18		
30-35	0.756	47.33%	3.782	23.410	21.519	2350	309	0.478	60000	**2.65**	0.15		
35-40	0.775	46.63%	3.873	27.283	25.347	2360	91	0.474	60000	**0.78**	0.09	0.43	0.04

Table 1.210Pb and 226Ra analysis from cores taken in 2018-025.

Core Depth (cm)	Dry Wt./ Wet cc. (g/cm3) (33 ppt corrected)	% Loss on Drying	Mass in extrapolated section (g/cm2)	Cumulative Mass to Bottom of Current Section (g/cm2)	Plot-point of cumulative mass in current section (g/cm2)	Po-209 counts less detector back-ground	Po-210 Counts Less Detector Back-ground and Po-209 Spike Standard Blank	Weight of Sample Counted-Salt (g)	Count Time (sec)	Po-210 Total Activity (DPM/g) (salt corrected)	Error Po 210 +/- 1 S.D. (DPM/g)	Ra-226 Activity (DPM/g dry wt.)	Error Ra-226 +/- 1 S.D. (DPM/g dry wt.)
Port1													
0-1	0.918	41.18%	0.918	0.918	0.459	1310	218	0.523	60000	**3.08**	0.21		
1-2	1.098	34.52%	1.098	2.016	1.467	1459	225	0.483	60000	**3.09**	0.21		
2-3	1.103	33.75%	1.103	3.119	2.567	1499	258	0.527	60000	**3.16**	0.23		
3-4	1.149	32.76%	1.149	4.268	3.694	1466	239	0.518	60000	**3.04**	0.20		
4-5	1.188	31.47%	1.188	5.456	4.862	1210	185	0.479	60000	**3.09**	0.23	0.65	0.04
5-6	1.200	31.16%	1.200	6.656	6.056					**3.05**	0.21		
6-7	1.276	29.07%	1.276	7.932	7.294	1473	214	0.491	60000	**2.86**	0.20		
7-8	1.266	29.18%	1.266	9.198	8.565	1493	224	0.477	60000	**3.04**	0.21		
8-9	1.234	29.89%	1.234	10.432	9.815	1485	228	0.493	60000	**3.02**	0.21		
9-10	1.228	30.43%	1.228	11.659	11.045	1349	230	0.506	60000	**3.26**	0.22		
10-12	1.274	28.89%	2.548	14.207	12.933	1034	149	0.514	60000	**2.71**	0.23		
12-14	1.264	29.22%	2.529	16.736	15.471	1240	193	0.508	60000	**2.97**	0.23		
14-16	1.346	26.80%	2.692	19.428	18.082	1273	185	0.518	60000	**2.71**	0.21	0.61	0.03
16-18	1.378	25.85%	2.756	22.184	20.806	1346	172	0.531	60000	**2.33**	0.18		
18-20	1.334	27.03%	2.668	24.852	23.518	1218	132	0.510	60000	**2.05**	0.18		
20-25	1.250	29.64%	6.248	31.100	27.976	1287	149	0.500	60000	**2.24**	0.19		
25-30	1.145	32.97%	5.723	36.823	33.962	1164	155	0.513	60000	**2.51**	0.20		
30-35	1.017	37.43%	5.084	41.907	39.365	1533	327	0.498	60000	**4.14**	0.26		
35-40	1.154	32.72%	5.769	47.676	44.791	1517	274	0.568	60000	**3.08**	0.19	0.67	0.04

Table 2. Freshwater endmembers for the Skeena River. Samples shown are those with the lowest salinity taken during each sampling expedition.

Cruise	2019-069	2019-083	2020-001	2020-083
Temperature (°C)	18.2	6.8	1.3	NA
Salinity (ppt)	0.1666	1.3	1.8	0.5901
$\delta^{18}O$ (ppt)	-16.6	-14.8	-14.9	-15.1
CDOM S		0.0162	0.0162	0.0147
CDOM *a* 350		5.01	4.15	7.48
TOC (µmol/L)	105.94	197.48	NA	NA
DOC (µmol/L)		194.96	191.08	
SPC (mg/L)		14.29	22.19	6.70
TPN (µg)		30.77	25.19	3.42
TNP(ug/L)		91.85		
TC_{org} (µg)		108.00	205.67	-27.22
TPCorg (ug/L)		322.39		
$\delta^{15}N$ [vs. air]			2.48	3.42
$\delta^{13}C_{org}$ (vs. PBD)			-26.15	-27.22
Ammonium (umol/L)	0.03			
Nitrite (umol/L)	4.27		11.53	5.41
Siliate (umol/L)	56.90		81.18	59.49
Phosphate (umol/L)	0.37		0.55	0.17