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HYDROGRAPHIC MEASUREMENTS COLLECTED ABOARD THE UNOLS SHIP R/V WALTON SMITH, 2014: WESTERN BOUNDARY TIME SERIES CRUISE: FLORIDA CURRENT

Cruise IDs: WS1403, WS1409, WS1414, WS1419

James A. Hooper V
Molly O. Baringer

Atlantic Oceanographic and Meteorological Laboratory
Miami, Florida
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James A. Hooper V
University of Miami / Cooperative Institute for Marine and Atmospheric Studies
NOAA/ Atlantic Oceanographic and Meteorological Laboratory
Miami, Florida

Molly O. Baringer
NOAA/ Atlantic Oceanographic and Meteorological Laboratory
Miami, Florida

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The findings and conclusion on this report are those of the authors and do not necessarily represent the views of the funding agency.

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Abstract

This report summarizes the four cruises along 27°N on the UNOLS ship R/V Walton Smith involving full-water-column CTD and lowered ADCP profiles, along with shipboard ADCP profiles, conducted within the Florida Straits to monitor the Florida Current. This report describes the processing of a Seabird Electronics Model 9/11+ CTD O2 system and water samples collected from up to 23 10-liter Niskin bottles lowered to the bottom. This report includes a description of the calibrations procedures and profiles of pressure, salinity (conductivity), temperature, and dissolved oxygen concentrations. Water samples were also collected at various depths and analyzed for salinity and oxygen concentrations to aid with CTD calibration. A total of 9 CTD-O2/LADCP stations were occupied during each of the four cruises.

1 Introduction

The Florida Current transport time series began in 1982, as NOAA recognized the importance of long-term monitoring of the current transport and water mass properties of the Florida Current across the Florida Straits to determine its inter-annual variability to determine the strength of the subtropical gyre. gyre. Variations in the strength of the subtropical gyre in relation to the North Atlantic Oscillation (NAO) has been proposed as an important mechanism in the atmosphere-ocean feedback within coupled models (e.g. Latif and Barnett, 1996). Monitoring of the Florida Current include a submarine cable, GPS measurements using drop sondes, as well as hydrographic measurements. All of these programs are collaborating with scientific analysis and logistics including ship time.

Hydrographic surveys consisting of a repeat LADCP/CTD/rosette section in the Florida Straits was carried out during 2014 (Figure 1 and Tables 1 - 4). These cruises consist of one day cruises on the R/V Walton Smith departing and returning to Miami, FL. A total of four cruises were completed consisting of a total of 26 LADCP/CTD/Rosette stations. Water samples (up to 9 for each station), LADCP, CTD data were collected on each cast to within 20 m of the bottom. Salinity and dissolved oxygen samples were analyzed from the majority of bottles sampled on the rosette.

Table 1: WS1403 CTD Cast Summary

Station	Date	Time (GMT)	Latitude	Longitude	Depth
0	04/24/14	07:52:54	27.000N	79.931W	135
1	04/24/14	07:07:39	27.003N	79.867W	250
2	04/24/14	06:08:24	26.992N	79.785W	367
3	04/24/14	04:40:42	27.006N	79.682W	515
4	04/24/14	03:20:53	27.003N	79.618W	633
5	04/24/14	01:46:21	27.008N	79.502W	745
6	04/24/14	00:12:26	27.006N	79.383W	660
7	04/23/14	22:59:14	27.001N	79.284W	603
8	04/23/14	21:50:23	27.002N	79.204W	471

Table 2: WS1409 CTD Cast Summary

Station	Date	Time (GMT)	Latitude	Longitude	Depth
0	07/23/14	08:47:51	27.003N	79.930W	132
1	07/23/14	07:58:19	26.997N	79.870W	242
2	07/23/14	06:23:59	27.009N	79.786W	363
3	07/23/14	04:34:08	27.008N	79.686W	511
4	07/23/14	02:52:40	27.003N	79.617W	620
5	07/23/14	01:07:36	27.002N	79.498W	746
6	07/22/14	23:33:03	27.002N	79.385W	639
7	07/22/14	22:05:42	27.008N	79.285W	601
8	07/22/14	20:55:13	27.006N	79.203W	466

Table 3: WS1414 CTD Cast Summary

Station	Date	Time (GMT)	Latitude	Longitude	Depth
0	09/18/14	10:35:20	27.005N	79.927W	139
1	09/18/14	09:34:22	27.002N	79.864W	253
2	09/18/14	08:25:37	27.001N	79.781W	375
3	09/18/14	06:54:27	27.008N	79.682W	517
4	09/18/14	05:29:24	27.008N	79.613W	639
5	09/18/14	03:36:49	27.006N	79.496W	749
6	09/18/14	01:17:20	27.002N	79.380W	673
7	09/17/14	23:54:11	27.003N	79.281W	601
8	09/17/14	22:43:19	27.003N	79.196W	459

Table 4: WS1419 CTD Cast Summary

Station	Date	Time (GMT)	Latitude	Longitude	Depth
0	12/12/14	10:05:47	27.000N	79.932W	134
1	12/12/14	09:17:55	27.002N	79.867W	250
2	12/12/14	08:17:14	26.997N	79.786W	368
3	12/12/14	06:57:55	27.003N	79.677W	532
4	12/12/14	05:40:48	27.001N	79.613W	640
5	12/12/14	04:03:43	26.996N	79.497W	742
6	12/12/14	02:31:43	27.002N	79.381W	658
7	12/12/14	01:14:30	27.000N	79.284W	606
8	12/12/14	00:07:54	26.998N	79.200W	472

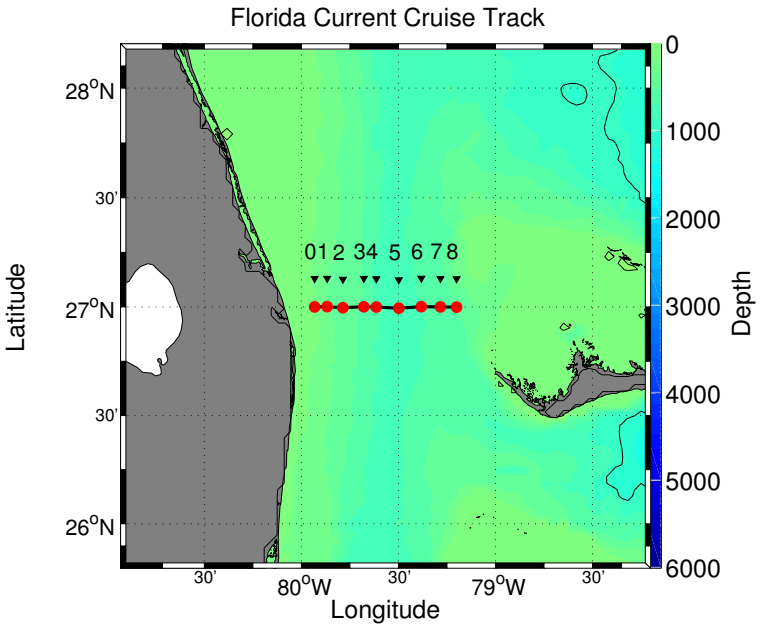


Figure 1: Florida Current CTD station locations. The landmasses are shaded. The red dots are the CTD stations.

2 Standards and Pre-Cruise Calibrations

The CTD/O2 system is a real-time data acquisition system with the data from a Sea-Bird Electronics, Inc. (SBE) 9plus underwater unit transmitted via a conducting cable to a SBE 11plus deck unit (V2). The serial data from the underwater unit is sent to the deck unit in RS-232 NRZ format. The deck unit decodes the serial data and sends it to a personal computer for display and storage in a disk file using Sea-Bird Seasave software (version 7.21).

The SBE 911plus system transmits data from primary and auxiliary sensors in the form of binary numbers equivalent to the frequency or voltage outputs from those sensors. These are referred to as the raw data. The SBE software performs the calculations required to convert raw data to engineering units.

The SBE 911plus system is electrically and mechanically compatible with the standard, unmodified carousel water sampler, also made by Sea-Bird Electronics, Inc. A modem and carousel interface allows the 911plus system to control the operations of the carousel directly without interrupting the flow of data from the CTD.

The SBE 911plus underwater unit is configured with dual standard modular temperature (SBE 3 plus) and conductivity (SBE 4) sensors, which are mounted near the lower end cap. The conductivity cell entrance is co-planar with the tip of the temperature sensor probe. The pressure sensor is mounted inside the underwater unit main housing. A centrifugal pump module flushes water through sensor tubing at a constant rate independent of the CTD's motion to improve dynamic performance. Dual dissolved oxygen sensors (SBE 43) are added to the pumped sensor configuration following the temperature-conductivity (TC) pair. A list of sensors used during the cruises can be seen in Table 5.

Table 5: Equipment used during the 2014 Florida Straits cruises.

Instrument	SN	Stations	Use	Pre-Cruise Calibration	Comment
Sea-Bird SBE 32 24-palce Carousel Water Sampler	N/A	0-8			All Cruises
Sea-Bird SBE9plus CTD	0511	0-8		10/01/12	WS1403, 1409, 1414
Paroscientific Digiquartz Pressure Sensor	70768	0-8		10/01/12	
Sea-Bird SBE9plus CTD	0768	0-8		04/25/12	WS1419
Paroscientific Digiquartz Pressure Sensor	92973	0-8		04/25/12	
Sea-Bird SBE3plus Temperature Sensor	1701	0-8	Primary	09/06/12	WS1403
Sea-Bird SBE3plus Temperature Sensor	1701	0-8	Primary	06/03/14	WS1409, 1414, 1419
Sea-Bird SBE3plus Temperature Sensor	5140	0-8	Secondary	02/07/14	WS1403, 1409, 1414
Sea-Bird SBE3plus Temperature Sensor	2946	0-8	Secondary	06/03/14	WS1419
Sea-Bird SBE4C Conductivity Sensor	1335	0-8	Primary	08/03/13	WS1403
Sea-Bird SBE4C Conductivity Sensor	3858	0-8	Primary	05/10/13	WS1409, 1414
Sea-Bird SBE4C Conductivity Sensor	1346	0-8	Primary	09/06/12	WS1419
Sea-Bird SBE4C Conductivity Sensor	2973	0-8	Secondary	10/26/12	WS1403
Sea-Bird SBE4C Conductivity Sensor	2973	0-8	Secondary	06/03/14	WS1409, 1414, 1419
Sea-Bird SBE43 Dissolved Oxygen Sensor	1266	0-8	Primary	03/04/14	WS1403, 1409, 1414
Sea-Bird SBE43 Dissolved Oxygen Sensor	2712	0-8	Primary	10/23/13	WS1419
Sea-Bird SBE43 Dissolved Oxygen Sensor	1348	0-8	Secondary	03/04/14	All Cruises
Simrad 807 Altimeter	gold	0-8			15.0 scale

2.1 Pressure

The Paroscientific series 4000 Digiquartz high pressure transducer uses a quartz crystal resonator whose frequency of oscillation varies with pressure induced stress measuring changes in pressure as small as 0.01 parts per million with an absolute range of 0 to 10,000 psia (0 to 6885 dbar). Repeatability, hysteresis and pressure conformance are 0.002% of full-scale. The nominal pressure frequency (0 to full scale) is 34 to 38 kHz. The nominal temperature frequency is 172 kHz $\pm$ 50 ppm/°C.

The pressure sensors used during the Florida Straits cruises were s/n 0511 and s/n 0768. Pre-cruise sensor calibrations were performed at Sea-Bird Electronics, Inc. in Bellevue, Washington. The following coefficient (Table 6) were entered into SEASAVE® using the configuration file:

Pressure coefficients are first formulated into:

$$\begin{aligned} c &= c_1 + c_2 * U + c_3 * U^2 \\ d &= d_1 + d_2 * U \\ t_0 &= t_1 + t_2 * U + t_3 * U^2 + t_4 * U^3 + t_5 * U^4 \end{aligned}$$

where U is temperature in degrees Celsius. Pressure is computed according to:

$$P\ (psia) = c * \left(1 - \frac{t_0^2}{t}\right) * \left[1 - d * \left(1 - \frac{t_0^2}{t}\right)\right]$$

where t is pressure period (μs). SEASAVE® automatically implements this equation.

Table 6: Pre-Cruise Calibration coefficients for the pressure sensor.

s/n 0511 October 01, 2012	s/n 0768 April 25, 2012
c_1 = -5.006884e+04	c_1 = -4.481307e+04
c_2 = -1.104210e-00	c_2 = -6.537544e-01
c_3 = 1.561210e-02	c_3 = 1.443500e-02
d_1 = 4.029500e-02	d_1 = 3.647800e-02
d_2 = 0.000000e+00	d_2 = 0.000000e+00
t_1 = 2.992485e+01	t_1 = 3.040635e+01
t_2 = -6.269641e-04	t_2 = -4.851470e-04
t_3 = 4.621850e-06	t_3 = 4.277270e-06
t_4 = -1.599760e-09	t_4 = 2.826110e-09
t_5 = 0.000000e+00	t_5 = 0.000000e+00
Slope = 1.00001000	Slope = 1.00001000
Offset = -1.93884	Offset = -2.54924
AD590M = 1.276300e-02	AD590M = 1.285440e-02
AD590B = -9.680950e+00	AD590B = -8.443560e+00

2.2 Temperature

The temperature-sensing element is a glass-coated thermistor bead, pressure protected by a stainless steel tube. The sensor output frequency ranges from 5–13 kHz corresponding to temperatures from -5 to 35°C. The output frequency is inversely proportional to the square root of the thermistor resistance, which controls the output of a patented Wien Bridge circuit. The thermistor resistance is exponentially related to temperature. The SBE 3 thermometer has a typical accuracy/stability of ±0.004°C per year and resolution of 0.0003°C at 24 samples per second. The SBE 3 thermometer has a fast response time of 0.070 seconds.

The temperature sensors (SBE 3plus) used during the Florida Straits cruises were serial numbers (s/n) 1701, 5140 and 2946. Pre-cruise sensor calibrations were performed at Sea-Bird Electronics, Inc. in Bellevue, Washington. The following coefficients (Table 7) were entered into SEASAVE® using the configuration file. SEASAVE® automatically implements the equation below and converts between ITS-90 and IPTS-68 temperature scales as desired. The Temperature (ITS-90) is computed from g, h, i, j and f_0 and f is the instrument frequency (kHz) coefficients as follows:

$$T\,(^\circ C) = \frac{1}{\left\{g + h * \left[\ln\left(\frac{f_0}{f}\right)\right] + i * \left[\ln^2\left(\frac{f_0}{f}\right)\right] + j * \left[\ln^3\left(\frac{f_0}{f}\right)\right]\right\}} - 273.15$$

Table 7: Pre-Cruise Calibration coefficients for the temperature sensors.

s/n 1701 September 06, 2012	s/n 1701 June 03, 2014	s/n 5140 February 07, 2014	s/n 2946 June 03, 2014
g = 4.79036330e-03	g = 4.79050738e-03	g = 4.36463665e-03	g = 4.34396030e-03
h = 6.53756525e-04	h = 6.53993411e-04	h = 6.40913384e-04	h = 6.39060473e-04
i = 1.84570428e-05	i = 1.85647190e-05	i = 2.22449273e-05	i = 2.13319840e-05
j = 1.00750672e-06	j = 1.02368630e-06	j = 2.06627300e-06	j = 1.82021671e-06
f_0 = 1000.0	f_0 = 1000.0	f_0 = 1000.0	f_0 = 1000.0

2.3 Conductivity

The flow-through conductivity-sensing element is a glass tube (cell) with three platinum electrodes (Seabird model SBE 4). The resistance measured between the center electrode and the end electrode pair is determined by the cell geometry and the specific conductance of the fluid within the cell, and controls the output frequency of a Wein Bridge circuit. The sensor has a frequency output of approximately 3 to 12 kHz corresponding to conductivity from 0 to 7 Siemens/meter (0 to 70 mmho/cm). The SBE 4 has a typical accuracy/stability of ± 0.0003 S·m^{-1}/month and resolution of 0.00004 S·m^{-1} at 24 scans per second.

The conductivity sensors used during the Florida Straits cruises were serial numbers (s/n) 1335, 3858, 1346 and 2973. Pre-cruise sensor calibrations were performed at Sea-Bird Electronics, Inc. in Bellevue, Washington. The coefficients shown in Table 8 & 9 were entered into Seasave using the configuration file.

Conductivity calibration certificates show an equation containing the appropriate pressure-dependent correction term to account for the effect of hydrostatic loading (pressure) on the conductivity cell:

$$C\ (Siemens/meter) = \frac{(g + h * f^2 + i * f^3 + j * f^4)}{[10 * (1 + c_{t_{cor}} * t + c_{p_{cor}} * p)]}$$

where g, h, i, j, $c_{t_{cor}}$, and $c_{p_{cor}}$ are the calibrations coefficients shown above, f is the instrument frequency (kHz), t is the water temperature (degrees Celsius), and p is the water pressure (dbar). SEASAVE® automatically implements this equation.

Table 8: Pre-Cruise Calibration coefficients for the conductivity sensors.

s/n 1335 April 03, 2013	s/n 3858 May 10, 2013	s/n 1346 September 06, 2012
g = -3.97048503e+00	g = -1.02245051e+01	g = -4.06197809e+00
h = 5.01616283e+01	h = 1.52915760e+00	h = 5.34978458e+01
i = 5.13497448e-05	i = -1.68168690e-03	i = 2.36824449e-05
j = 2.51963126e-05	j = 2.13345157e-04	j = 3.06435606e-05
CPcor = -9.5700e-08	CPcor = -9.5700e-08	CPcor = -9.5700e-08
CTcor = 3.2500e-06	CTcor = 3.2500e-06	CTcor = 3.2500e-06

Table 9: Pre-Cruise Calibration coefficients for the conductivity sensors.

s/n 2973 October 06, 2012	s/n 2973 June 03, 2014
g = -9.96027889e+00	g = -9.95489419e+00
h = 1.34616352e+00	h = 1.34447627e+00
i = 5.85658920e-05	i = 4.95505363e-04
j = 6.74097241e-05	j = 3.96581562e-05
CPcor = -9.5700e-08	CPcor = -9.5700e-08
CTcor = 3.2500e-06	CTcor = 3.2500e-06

2.4 Dissolved Oxygen

The SBE 43 dissolved oxygen sensor uses a membrane polarographic oxygen detector (MPOD). Oxygen sensors determine the dissolved oxygen concentration by counting the number of oxygen molecules per second (flux) that diffuse through a membrane. By knowing the flux of oxygen and the geometry of the diffusion path, the concentration of oxygen can be computed. The permeability of the membrane to oxygen is a function of temperature and ambient pressure. In order to minimize the errors in the oxygen measurement due to the temperature differences between the water and the oxygen sensor, a temperature compensation is calculated using a temperature measured near the active surface of the sensor. The interface electronics output voltages proportional to the temperature-compensated oxygen current. Initial computation of dissolved oxygen in engineering units is done in the software. The range for dissolved oxygen is 120% of surface saturation in all natural waters, fresh and salt, and the nominal accuracy is 2% of saturation.

Under extreme pressure, changes can occur in gas permeable Teflon membranes that affect their permeability characteristics. Some of these changes (plasticization and amorphous/crystalinity ratios) have long time constants and depend on the sensor's time-pressure history. These slow processes result in hysteresis in long, deep casts. The hysteresis correction algorithm operates through the entire data profile and corrects the oxygen voltage

values for changes in membrane permeability as pressure varies. At each measurement, the correction to the membrane permeability is calculated based on the current pressure and how long the sensor spent at previous pressures.

Sea-Bird has implemented an optional hysteresis correction for dissolved oxygen data. The correction algorithm requires a continuous time series of data, with no temporal data gaps (although a continuous time series is necessary, a constant sampling interval is not required). Prior to processing, do not remove any data from the downcast or upcast (if to be used), other than a surface soak at the beginning of the downcast.

Oxygen sensors 1266, 2712, and 1348 were used during the Florida Straits cruises. The following oxygen coefficients (Table 10) were entered into SEASAVE® using the configuration file:

Table 10: Pre-Cruise Calibration coefficients for the dissolved oxygen sensors.

s/n 1266 March 04, 2014	s/n 2712 October 12, 2013	s/n 1348 March 04, 2014
Soc = 0.4227	Soc = 0.4359	Soc = 0.3542
Voffset = -0.5336	Voffset = -0.5267	Voffset = -0.5139
Tau20 = 1.36	Tau20 = 1.48	Tau20 = 1.07
A = -3.2173e-03	A = -1.4276e-03	A = -3.6375e-03
B = 1.5887e-04	B = 5.6096e-05	B = 2.0198e-04
C = -2.3498e-06	C = -1.0922e-06	C = -2.7879e-06
$E_{nominal}$ = 0.036	$E_{nominal}$ = 0.036	$E_{nominal}$ = 0.036

The use of these constants in linear equations of the form $I = mV + b$ and $T = kV + c$ yield sensor membrane current and temperature (with maximum error of about 0.5 °C) as a function of sensor output voltage.

Dissolved oxygen concentration is calculated according to:

$$O\ (ml/l) = \{Soc * (V + V_{offset} + tau(T,S) * \frac{\delta v}{\delta t}) + p1 * station\}$$
$$*(1.0 + A * T + B * T^2 + C * T^3) * OXSAT(T,S) * e^{E*(\frac{P}{K})}$$

where Soc, V_{offset}, tau, A, B, C, E and $p1$ are the calibration coefficients shown above and V is the instrument voltage (V). T, S and P are the temperature, salinity and pressure measured by the CTD. K is the temperature in the absolute scale (K), $\delta v/\delta t$ is the oxygen voltage time derivative, *station* is the station number, and $OXSAT$ is the oxygen saturation

value calculated according to (Weiss, 1970):

$$OXSAT(\theta, S) = \exp\left\{A_1 + A_2 * \left(\frac{100}{\theta}\right) + A_3 * \ln\left(\frac{\theta}{100}\right) + A_4 * \left(\frac{\theta}{100}\right) + S * \left[B_1 + B_2 * \left(\frac{\theta}{100}\right) + B_3 * \left(\frac{\theta}{100}\right)^2\right]\right\}$$

where θ is the absolute temperature (K); and

$$\begin{array}{llll} A_1 = & -173.4292 & B_1 = & -0.033096 \\ A_2 = & 249.6339 & B_2 = & 0.014259 \\ A_3 = & 143.3483 & B_3 = & -0.00170 \\ A_4 = & -21.8492. & & \end{array}$$

SEASAVE® automatically implements this equation.

The hysteresis correction is calculated, using the oxygen voltages, with the following algorithm:

$$D = 1 + H_1 * (e^{\left(\frac{P(i)}{H2}\right)} - 1)$$

$$C = e(-1 * \left(\frac{Time(i) - Time(i-1))}{H3}\right)$$

$$O_V(i) = O_{volt}(i) + V_{offset}$$

$$O_{newvolts}(i) = a * \frac{a}{D}$$

$$O_{finalvolts}(i) = O_{newvolts}(i) - V_{offset}$$

Where:

i = indexing variable (must be a continuous time series to work; can be performed on bin averaged data), where i = 1:end (end is largest data index point plus 1).
$P(i)$ = pressure (decibars) at index point i .
$Time(i)$ = time (seconds) from start of index point i.
$O_{volt}(i)$ = SBE 43 oxygen voltage output directly from sensor, with no calibration or hysteresis corrections, at index point i.
V_{offset} = correction for an electronic offset that is applied to voltage output of sensor. V_{offset} correction is always negative (see factory calibration sheet for this coefficient). V_{offset} is added to raw voltages prior to hysteresis correction. At end of hysteresis corrections, V_{offset} is removed prior to data conversion using SBE 43 calibration equation (see $O_{finalvolts}(i)$).
$O_V(i)$ = dissolved oxygen voltage value with V_{offset} correction (made prior to hysteresis correction) at index point i.
D and C are temporary variables used to simplify expression in processing loop.
$H1$ = amplitude of hysteresis correction function. Default = -0.033, range = -0.02 to -0.05 (varies from sensor to sensor).
$H2$ = function constant or curvature function for hysteresis. Default = 5000.

$H3$ = time constant for hysteresis (seconds). Default = 1450, range = 1200 to 2000 (varies from sensor to sensor).
$O_{newvolts}(i)$ = hysteresis-corrected oxygen value at index point i.
$O_{finalvolts}(i)$ = hysteresis-corrected oxygen value at index point i with V_{offset} removed.

This step is necessary prior to computing oxygen concentration using SBE 43 calibration equation.

3 Data Acquisition

CTD/rosette casts were performed with a package consisting of a 24-place, 10-liter rosette frame, a 24-place water sampler (SBE32) and 23, 10-liter Bullister-style bottles. This package was deployed on all stations/casts. Underwater electronic components consisted of a Sea-Bird Electronics (SBE) 9 plus CTD with dual pumps and the following sensors: dual temperature (SBE3), dual conductivity (SBE4), dual dissolved oxygen (SBE43), and a Simrad 807 altimeter. Some cruises included a fluorometer (not reported herein). The other underwater electronic components typically consisted of two RDI LADCPs (also not reported herein). A total of 36 CTD/rosette casts were made between all four cruises, usually to within 20 m of the bottom.

The CTD's supplied a standard Sea-Bird format data stream at a data rate of 24 frames/second. The SBE9 plus CTD was connected to the SBE32 24-place pylon providing for single-conductor sea cable operations. Power to the SBE9 plus CTD, SBE32 pylon, auxiliary sensors, and altimeter was provided through the sea cable from the SBE911 plus deck unit in the computer lab. The rosette system was suspended from a UNOLS-standard three-conductor 0.322" electro-mechanical sea cable.

The CTD was mounted vertically attached to the bottom center of the rosette frame. All SBE4 conductivity and SBE3 temperature sensors and their respective pumps were mounted vertically as recommended by SBE, outboard of the CTD. The CTD was outfitted with dual pumps. Primary temperature, conductivity, and dissolved oxygen were plumbed on one pump circuit and secondary temperature, conductivity, and dissolved oxygen on the other. Pump exhausts were attached to outside corners of the CTD cage and directed downward. The altimeter was mounted on the inside of a support strut adjacent to the bottom frame ring. The LADCP's were vertically mounted inside the bottle rings with one 300 kHz pointing down, the other 300 kHz transducer pointing up. The R/V Walton Smith's stern A-frame CTD winch was used with the 24-place 10-liter rosette for all station/casts. However, only at most 23 water samples are collected due to the presence of an upward looking ADCP in place of one Niskin bottle.

O-rings were changed as necessary and bottle maintenance was performed each day to insure proper closure and sealing. Valves were inspected for leaks and repaired or replaced as needed.

3.1 Data Acquisition

The CTD data acquisition system consisted of an SBE-11plus (V2) deck unit and a networked generic PC workstation located in the aft of the science lab. SBE Seasave software version 7.21 was used for data acquisition and to close bottles on the rosette.

The console watch initiated CTD deployments after the ship stopped on station. The watch maintained a console operations log containing a description of each deployment, a

record of every attempt to close a bottle and any pertinent comments.

Prior to each cast the CTD was powered on and an on deck surface pressure was recorded and then powered off before deployment. The deck watch leader directed the winch operator to raise the package, the stern A-frame and rosette were extended outboard, and the package quickly lowered into the water and submerged to 10-15 meters of wire out. Tag lines were necessary for both deployments and recoveries during this cruise. The CTD sensor pumps were configured with a 60 second startup delay. The CTD console operator waited for the CTD sensor pumps to turn on, waiting for 2-3 minutes for sensors to stabilize, then directed the winch operator to bring the package close to the surface, pause for typically 10 seconds, hitting "Mark Scan" and begin the descent. The profiling rate was no more than 30 m/min to 150 m and no more than 60 m/min deeper than 150 m depending on sea cable tension and the sea state.

The console watch monitored the progress of the deployment and quality of the CTD data through interactive graphics and operational displays. Additionally, the watch created a sample log for the deployment that would be later used to record the correspondence between rosette bottles and analytical samples taken. The altimeter channel, CTD pressure, wire-out and bathymetric depth were all monitored to determine the distance of the package from the bottom, usually allowing a safe approach to within 20 m.

On the up cast, the winch operator was directed to stop at each bottle trip depth. The CTD console operator waited 30 seconds before tripping a bottle using a "point and click" graphical trip button. The data acquisition system responded with trip confirmation messages and the corresponding CTD data in a rosette bottle trip window on the display. All tripping attempts were noted on the console log. The console watch then directed the winch operator to raise the package up to the next bottle trip location.

After the last bottle was tripped, the console watch directed the deck watch to bring the rosette on deck. Once on deck, the console watch terminated the data acquisition, turned off the deck unit, and assisted with rosette sampling.

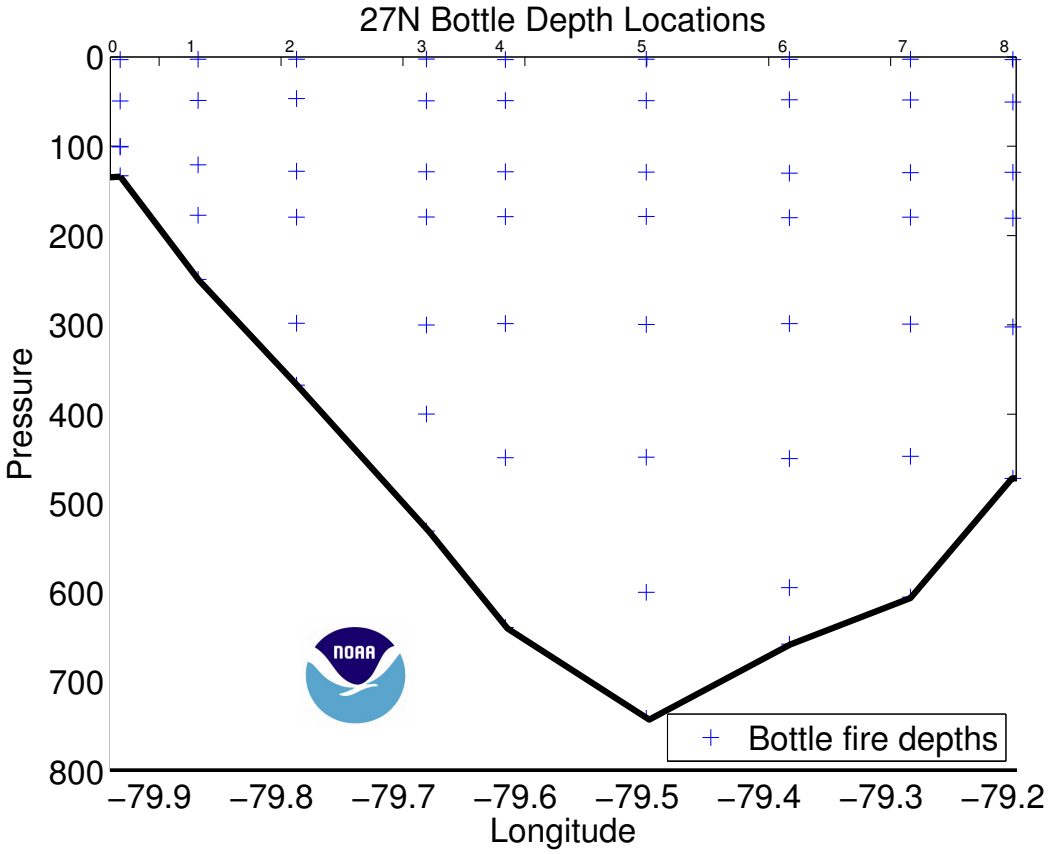


Figure 2: Nominal bottle locations for 27°N section in the Florida Straits.

3.2 Preliminary CTD Data Processing

Preliminary CTD data processing was performed using SEABIRD SBE Data Processing version 7.21k and AOML Matlab processing software. The raw CTD data and bottle trips acquired by SBE Seasave on the Windows 7 workstation were copied onto the CTD-PROC workstation, and processed to a 1-dbar series and a 1-second time series. Bottle trip values were extracted and a 1-decibar (dbar) down cast pressure series created.

Raw data are acquired from the instruments and are stored unmodified. The conversion module DATCNV uses the instrument configuration and pre-cruise factory calibration coefficients to create a converted engineering unit data file that is utilized by all SBEDataProc® post processing modules. Unless otherwise noted, all calibration parameters given are factory default values recommended by Sea Bird Electronics, Inc. The following is the SBEDataProc® processing module sequence and specifications for primary calibrated data (1 dbar averages) uses the following routines in order for reduction of CTD/O2 data from this cruise:

1. DATCNV converts raw data into engineering units and creates a .ROS bottle file. Both down and up casts were processed for scan, elapsed time(s), depth, pressure, t0 ITS-90 C, t1 ITS-90 C, c0 S/cm, c1 S/cm, salinity (PSU), salinity 2 (PSU), oxygen voltage V, oxygen 2 voltage V, altimeter, optical sensor, oxygen umol/kg, oxygen 2 umol/kg, oxygen mll/l, oxygen 2 ml/l, oxygen dv/dt, oxygen dv/dt 2, latitude, and longitude. MARKSCAN was used to determine the number of scans acquired on deck and while priming the system to exclude these scans from processing.

2. ALIGNCTD aligns temperature, conductivity, and oxygen measurements in time relative to pressure to ensure that derived parameters are made using measurements from the same parcel of water. Secondary conductivity and oxygen were automatically advanced by 0.073 seconds.

3. BOTTLESUM creates a summary of the bottle data. Bottle position, date, and time were output automatically. Pressure, temperature, conductivity, salinity, oxygen voltage and preliminary oxygen values were averaged over a 5 second interval.

4. WILDEDIT computes the standard deviation of 100 point bins, and then makes two passes through the data. The first pass flags points that differ from the mean by more than 2 standard deviations. A new standard deviation is computed excluding the flagged points and the second pass marks bad values greater than 20 standard deviations from the mean. For this data set, data were kept within a distance of 100 of the mean (i.e., all data).

5. FILTER applies a low pass filter to pressure with a time constant of 0.15 seconds. In order to produce zero phase (no time shift), the filter is first run forward through the file and then run backwards through the file.

6. CELLTM uses a recursive filter to remove conductivity cell thermal mass effects from measured conductivity. In areas with steep temperature gradients the thermal mass correction is on the order of 0.005 PSS-78. In other areas the correction is negligible. The value used for the thermal anomaly amplitude (alpha) was 0.03°C. The value used for the thermal anomaly time constant (1/beta) was 7.0°C.

7. LOOPEDIT removes scans associated with pressure slowdowns and reversals. If the CTD velocity is less than 0.25 m/s or the pressure is not greater than the previous maximum scan, the scan is omitted.

8. DERIVE uses 1 dbar averaged pressure, temperature, and conductivity to compute primary and secondary salinities. Oxygen voltage is used to calculate oxygen concentrations.

9. BINAVG averages the data into 1 dbar bins. Each bin is centered on an integer pressure value, e.g., the 1 dbar bin averages scans where pressure is between 0.5 dbar and 1.5 dbar. There is no surface bin. The number of points averaged in each bin is included in the data file.

10. STRIP removes the computed oxygen variable.

11. TRANS converts the binary data file into ASCII format.

12. SPLIT separates the cast into upcast and downcast values.

Package slowdowns and reversals owing to ship roll can move mixed water in tow to in front of the CTD sensors and create artificial density inversions and other artifacts. In addition to Seasoft module LOOPEDIT, a program computes values of density locally referenced between every 1 dbar of pressure to compute N^2 and linearly interpolates temperature, conductivity, and oxygen voltage over those records where N^2 is less than or equal to -1 x 10^{-5} s^{-2}. These data were retained but flagged as questionable in the final WOCE formatted files.

Final calibrations are applied to delooped data files. ITS-90 temperature, salinity, and oxygen are computed, and WOCE quality flags are created.

CTD data were examined at the completion of each deployment for clean corrected sensor response and any calibration shifts. As bottle salinity and oxygen results became available, they were used to refine shipboard conductivity and oxygen sensor calibrations.

A total of 36 casts were processed.

3.3 CTD Calibration Procedures

Laboratory calibrations of the CTD pressure, temperature, conductivity, and oxygen sensors were all performed at SBE. The calibration dates are listed in Table 5.

Secondary temperature, conductivity and dissolved oxygen (T2, C2 and DO2) sensors served as calibration checks for the reported primary sensors. During the cruise, it was determined that the primary sensors behaved more stably during the cruise.

In-situ salinity and dissolved O2 check samples collected during each cast were used to calibrate the conductivity and dissolved O2 sensors.

3.3.1 Salinity Analysis

A single Guildline Autosal (s/n 71011), model 8400B, located in 1st floor of AOML, was used for all salinity measurements. The autosal used was provided by AOML and last calibrated August 23, 2012. The salinometer readings were logged on a computer using Ocean Scientific International's logging hardware and software. The Autosal's water bath temperature was set to 24°C, which the Autosal is designed to automatically maintain. The laboratory's temperature is typically set and maintained to just below 24°C, to help further stabilize reading values and improve accuracy. The room temperature was monitored by a digital thermometer. Salinity analyses were performed after samples had equilibrated to laboratory temperature, usually within a couple days after collection. The salinometer was standardized for each group of samples analyzed (usually 2 casts and up to 52 samples) using two bottles of standard seawater: one at the beginning and end of each set of measurements. The salinometer output was logged to a computer file. The software prompted the analyst to flush the instrument's cell and change samples when appropriate. Prior to each run a sub-standard flush, approximately 200 ml, of the conductivity cell was conducted to flush out the DI water used in between runs. For each calibration standard, the salinometer cell was initially flushed 6 times before a set of conductivity ratio reading was taken. For each sample, the salinometer cell was initially flushed at least 3 times before a set of conductivity ratio readings were taken.

IAPSO Standard Seawater Batch P-155 and P-154 was used to standardize the casts (Table 11).

Table 11: Nominal values for the batches of IAPSO standard seawater.

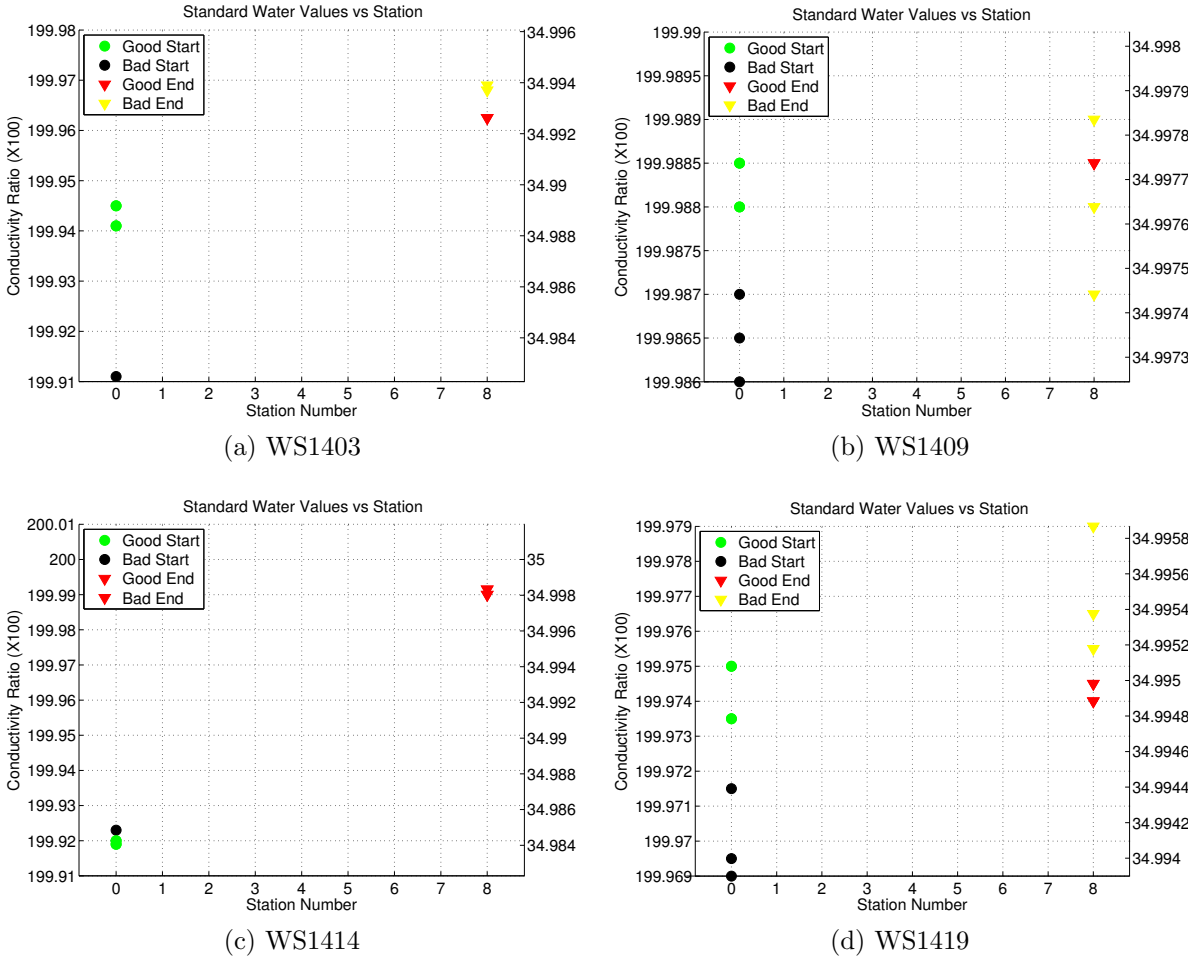
WS1403 & WS1419	WS1409 & WS1414
P-155	P-154
Use By: September 2015	Use By: October 2014
K15: 0.99981	K15: 0.99990
Salinity: 34.993	Salinity: 34.996

The salinity samples were collected in 200 ml Kimax high-alumina borosilicate bottles that had been rinsed at least three times with sample water prior to filling. The bottles were sealed with custom-made plastic insert thimbles and Nalgene screw caps. This assembly provides very low container dissolution and sample evaporation. Prior to sample collection, inserts were inspected for proper fit and loose inserts replaced to insure an airtight seal. Laboratory temperature was also monitored electronically throughout the cruise. PSS-78 salinity [UNES81] was calculated for each sample from the measured conductivity ratios. The offset between the initial standard seawater value and its reference value was applied to each sample. Then the difference (if any) between the initial and final vials of standard seawater was applied to each sample as a linear function of elapsed run time. The corrected salinity data was then incorporated into the cruise database. During the four Florida Straits cruises, a total of 184 salinity measurements were taken.

The running standard calibration values are shown in Figure 3. For WS1403 the autosal standards changed by 0.0004 in conductivity ratio (about 0.006 in salinity). For WS1409 the autosal standards changed by 0.00003 in conductivity ratio (about 0.0005 in salinity). For WS1414 the autosal standards changed by 0.0007 in conductivity ratio (about 0.014 in salinity). For WS1419 the autosal standards changed by 0.0001 in conductivity ratio (about 0.0018 in salinity).

3.3.2 Oxygen Analysis

Dissolved oxygen analyses were performed with an automated titrator using amperometric end-point detection (Langdon, 2010). Sample titration, data logging, and graphical display were performed with a PC running a LabView program written by Ulises Rivero of AOML. Thiosulfate (17.5g per 500 ml) was dispensed by a 2 ml Gilmont burette driven with a stepper motor controlled by the titrator. Tests in the lab were performed to confirm that the precision and accuracy of the volume dispensed were comparable or superior to the Dosimat 665. The whole-bottle titration technique of Carpenter (1965), with modifications by Culberson et al. (1991), was used. Four replicate 10 ml iodate standards were run initially and if there requires any fill of new Thiosulfate and once again after bottle has reached half volume. The reagent blank determined as the difference between V1 and V2, the volumes of Thiosulfate required to titrate 1ml aliquots of the iodate standard. This method was found to produce a



(a) WS1403

(b) WS1409

(c) WS1414

(d) WS1419

Figure 3: Standard vial calibrations throughout the cruise.

more reproducible blank value than the value determined as the intercept of a standard curve.

Dissolved oxygen samples were drawn from Niskin bottles into calibrated 125-150ml iodine titration flasks using silicon tubing. Bottles were rinsed three times and filled from the bottom, overflowing three volumes while taking care not to entrain any bubbles. The CTD temperatures were used to calculate $umol/kg$ concentrations. 1ml of MnCl2 and 1ml of NaOH/NaI were added immediately after drawing the sample was concluded using a ThermoScientific REPIPET II. The flasks were then stoppered and shaken well. Deionized water (DIW) was added to the neck of each flask to create a water seal. The total number of oxygen samples collected from the rosette was 222. The samples were stored in the lab in plastic totes at room temperature and run once back at AOML. The data was incorporated into the cruise database shortly after analysis. Thiosulfate normality was calculated from the laboratory temperature for each sample run.

The dispenser used for the standard solution (SOCOREX Calibrex 520) and the burette were calibrated gravimetrically just before the cruise. Oxygen flask volumes were determined gravimetrically with degassed deionized water at AOML. The correction for buoyancy was applied.

4 Post-Cruise Calibrations

Post cruise sensor calibrations were not done at Sea-Bird Electronics, Inc. Secondary temperature, conductivity and dissolved oxygen sensors served as calibration checks for the reported primary sensors.

In-situ salinity and dissolved oxygen samples collected during each cast were used to calibrate the conductivity and dissolved oxygen sensors.

Several sensor combinations were used during the cruises as listed in Table 5. For WS1403 the primary T, C, and O were selected for final data reduction. For WS1409, WS1414, and WS 1429 the secondary T, C, and O were selected for final data reduction. In addition to the Seasave processing modules, a group of Matlab script files called AOML/CTDCAL Toolbox were used. These scripts were based on earlier work of different groups as well as in modern statistical tools. They cover all the steps of the CTD data processing from the preliminary comparisons between sensors or bottle samples to data reductions and final sensors calibrations.

4.1 CTD Data Processing

By using the post cruise sensors calibrations; time drifts were estimated for the temperature and conductivity sensors (for estimated time drifts see the appropriate sections below). The processing module sequence used at sea is done again to include the time drifts as well the pressure correction. After this step the following Matlab scripts based on PMEL programs are applied to the CTD data:

- FILL_SURFACE was used to copy the first good value of salinity, potential temperature, oxygen and oxygen current back to the surface. The program then calculated temperature and conductivity, and zeroed doc/dt of oxygen current for those records.

- DESPIKE1 removed spikes from primary oxygen current and oxygen temperature data, as well as removing spikes from the primary conductivity sensor. Data were linearly interpolated over de-spiked records. Conductivity was back calculated, and sigma-theta and potential temperature were recomputed for the interpolated records.

- DESPIKE2 removed spikes from secondary sensors in the same method as DESPIKE1.

- Package slowdown and reversals due to ship roll can move mixed water in tow in front of the CTD sensors. This mixture can create artificial density inversions and other artifacts. In addition to the SEASOFT module LOOPEDIT, DELOOP, computes values of density locally referenced between every 1 dbar of pressure to compute N^2 = (- g/p) (dp/dz) and linearly interpolated measured parameters over those records where $N^2 \leq$ -1.0 e -05 s^{-2}.

4.2 CTD Pressure

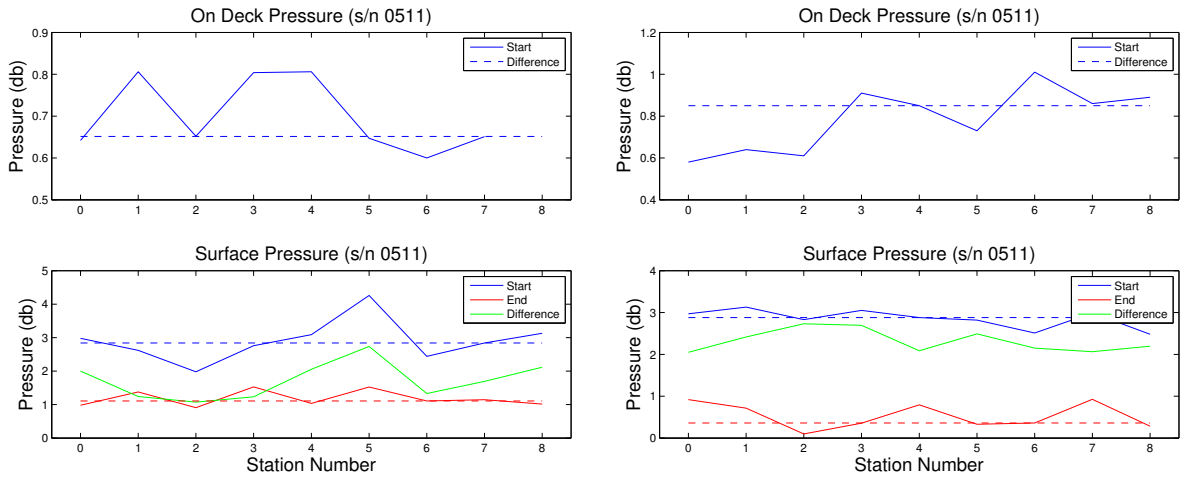
Pressure sensor calibration coefficients derived from the pre-cruise calibrations were applied to raw pressure data during each cast. Residual pressure offsets (the difference between the first and last submerged pressures) were examined to check for calibration shifts (see Figure 4 and Tables 12 - 15. During WS1403, WS1409, and WS1414 pressure sensor s/n 0511 was used and during WS1419 pressure sensor s/n 0768 was used. On deck pressures before the start of each cast was recorded and is plotted in Figure 4.

For WS1403 the on deck pressure before the cast was stable at 0.65 ± 0.087 dbar. A pressure offset correction of 0.65 dbar was applied before final calibration of the data. Near surface pressure values (which is taken as the near-surface pressure at the markscan and the last fired bottle pressure) showed larger variability, but no remarkable trends over the cruise (2.84 ± 0.62 dbar before and 1.11 ± 0.24 dbar after).

For WS1409 the on deck pressure before the cast was stable at 0.85 ± 0.15 dbar. A pressure offset correction of 0.85 dbar was applied before final calibration of the data. Near surface pressure values (which is taken as the near-surface pressure at the markscan and the last fired bottle pressure) showed a large shift over the cruise between the start and end surface pressure (2.88 ± 0.23 dbar before and 0.36 ± 0.31 dbar after).

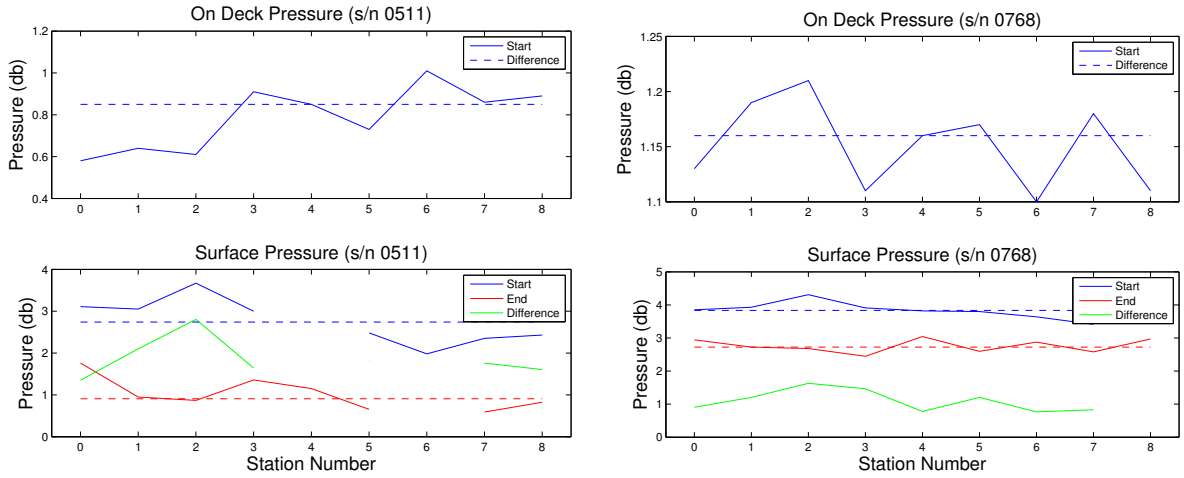
For WS1414 the on deck pressure before the cast was stable at 0.65 ± 0.087 dbar. A pressure offset correction of 0.65 dbar was applied before final calibration of the data. Near surface pressure values (which is taken as the near-surface pressure at the markscan and the last fired bottle pressure) also showed a large shift over the cruise between the start and end surface pressure (2.74 ± 0.54 dbar before and 0.91 ± 0.39 dbar after).

For WS1419 the on deck pressure before the cast was stable at 1.161± 0.039 dbar. A pressure offset correction of 1.16 dbar was applied before final calibration of the data. Near surface pressure values (which is taken as the near-surface pressure at the markscan and the last fired bottle pressure) showed larger variability, but no remarkable trends over the cruise (3.84 ± 0.26 dbar before and 2.72 ± 0.24 dbar after).



(a) WS1403

(b) WS1409



(c) WS1414

(d) WS1419

Figure 4: Pressure differences vs. station number. Top panel are the pressures measured on deck before the cast (blue). Bottom panel are the near sea surface pressure values measured at the start of the downcast (blue), at the end of the upcast (red) and their respective difference (green).

Table 12: WS1403 near surface Pressure values and scan number used to remove surface soak and on-deck values.

Station	Markscan	Deck Prs Start	Sfc Prs Start	Sfc Prs End
0	189	0.6420	2.9800	0.9810
1	81	0.8060	2.6200	1.3780
2	284	0.6520	1.9800	0.9070
3	157	0.8040	2.7600	1.5280
4	142	0.8060	3.0900	1.0360
5	644	0.6470	4.2600	1.5250
6	119	0.6000	2.4400	1.1080
7	142	0.6510	2.8400	1.1470
8	153		3.1300	1.0140

Table 13: WS1409 near surface Pressure values and scan number used to remove surface soak and on-deck values.

Station	Markscan	Deck Prs Start	Sfc Prs Start	Sfc Prs End
0	7564	0.5800	2.9700	0.9200
1	8963	0.6400	3.1300	0.7150
2	7331	0.6100	2.8300	0.0990
3	9820	0.9100	3.0500	0.3560
4	4480	0.8500	2.8800	0.7940
5	6715	0.7300	2.8200	0.3300
6	7091	1.0100	2.5100	0.3600
7	5766	0.8600	2.9900	0.9260
8	4705	0.8900	2.4800	0.2840

Table 14: WS1414 near surface Pressure values and scan number used to remove surface soak and on-deck values.

Station	Markscan	Deck Prs Start	Sfc Prs Start	Sfc Prs End
0	7564	0.5800	3.1100	1.7610
1	8963	0.6400	3.0500	0.9490
2	7331	0.6100	3.6700	0.8670
3	9820	0.9100	3.0000	1.3570
4	4480	0.8500		1.1500
5	6715	0.7300	2.4800	0.6550
6	7091	1.0100	1.9800	
7	5766	0.8600	2.3500	0.5890
8	4705	0.8900	2.4300	0.8250

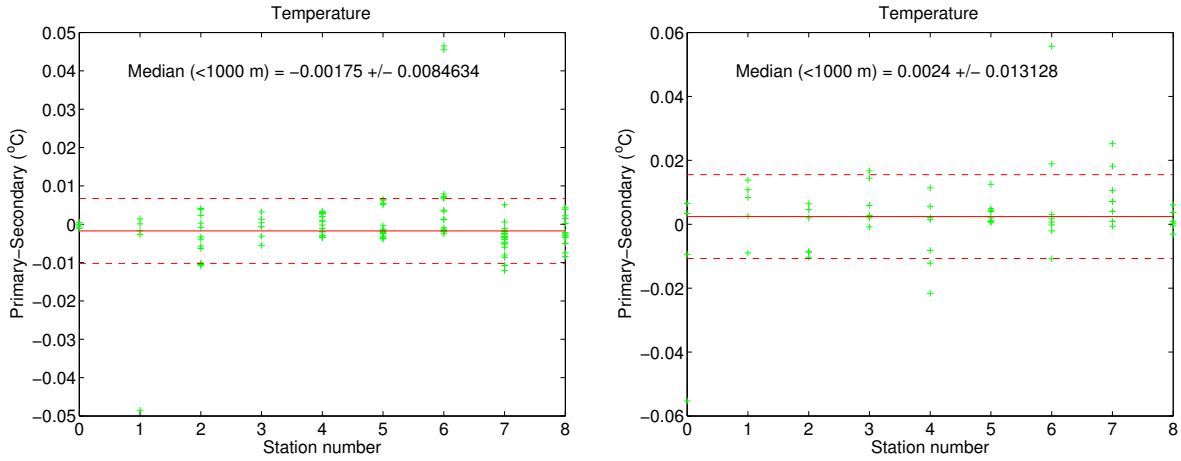
Table 15: WS1419 near surface Pressure values and scan number used to remove surface soak and on-deck values.

Station	Markscan	Deck Prs Start	Sfc Prs Start	Sfc Prs End
0	1256	1.1300	3.8500	2.9460
1	1426	1.1900	3.9300	2.7250
2	1694	1.2100	4.3100	2.6800
3	2990	1.1100	3.9100	2.4470
4	3396	1.1600	3.8200	3.0420
5	2705	1.1700	3.8000	2.5970
6	1575	1.1000	3.6400	2.8750
7	2102	1.1800	3.4100	2.5790
8	1870	1.1100		2.9710

4.3 CTD Temperature

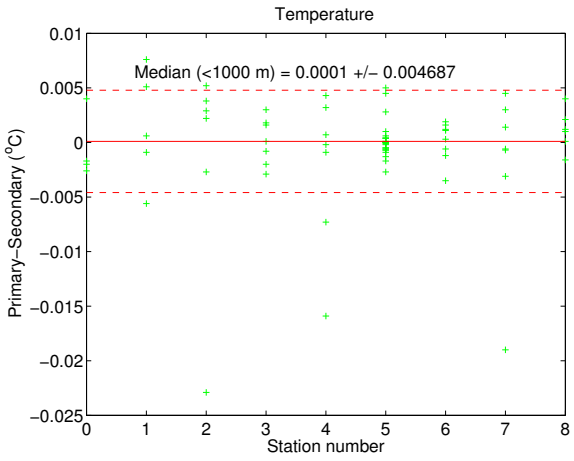
Temperature sensor calibration coefficients derived from the pre-cruise calibrations were applied to raw primary and secondary temperature data during each cast. Data accuracy, reproducibility and stability were examined by tabulating the difference between the two different temperature sensors over a range of pressures (bottle trip locations) for each cast.

These comparisons are summarized in Figure 5, which shows the median temperature difference between the two sensors. For WS1403 there was a median of -0.0017 °C and a standard deviation of 0.00084°C. For WS1409 there was a median of 0.0024 °C and a standard deviation of 0.013 °C. For WS1414 there was a median of 0.0001 °C and a standard deviation of 0.0046 °C. For WS1419 there was a median of 0.0015 °C and a standard deviation of 0.0038 °C.

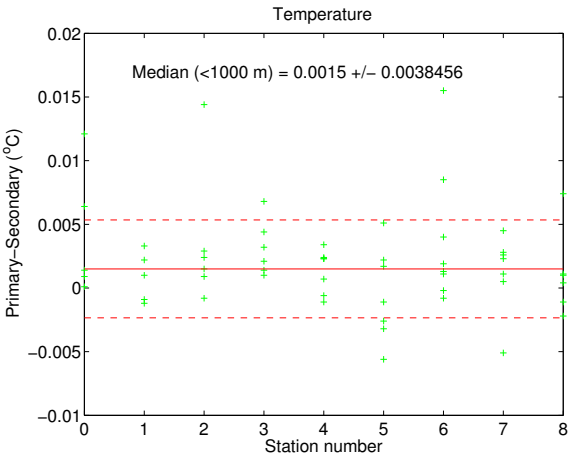


(a) WS1403

(b) WS1409



(c) WS1414

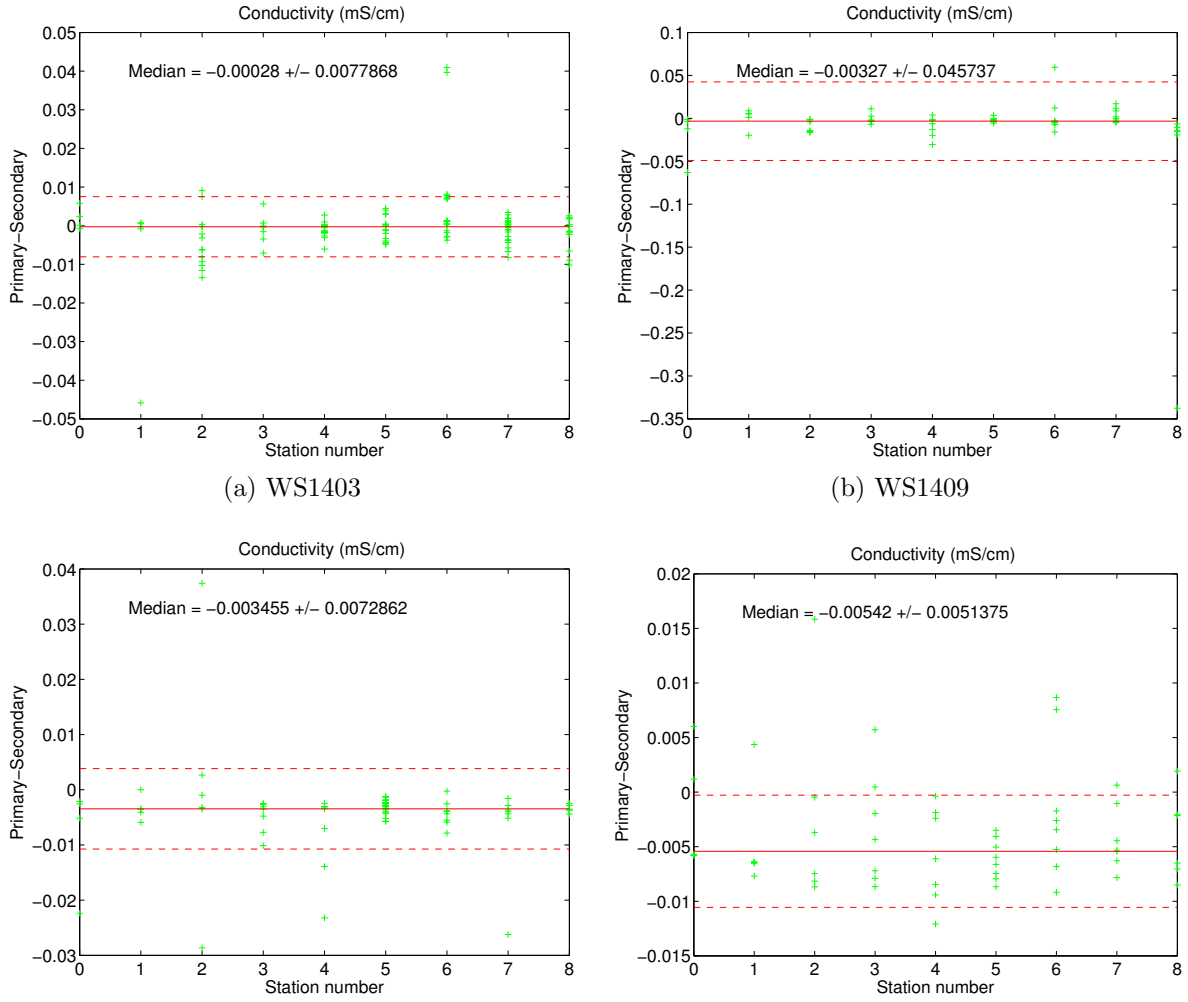


(d) WS1419

Figure 5: Temperature differences (after corrections) between sensors by station number (top) and pressure (bottom). The green represents the surface data down to 1000 dbar. The blue represents data below 1000 dbar. The red solid line represents the median with the red dashed representing the standard deviation (same for top and bottom).

4.4 Conductivity

Conductivity sensor calibration coefficients derived from the pre-cruise calibrations were applied to raw primary and secondary conductivities. Comparisons between the primary and secondary sensors and between each of the sensors to conductivity calculated from bottle salinities were used to derive conductivity corrections. Uncorrected C1-C2 are shown in Figure 6 to help identify sensor drift. The AOML/CTDCAL Toolbox automatically applies a quality control to the data based on comparison with a normal distribution.



(a) WS1403 (b) WS1409

(c) WS1414 (d) WS1419

Figure 6: Conductivity (mS/cm) differences between sensors by station (top) and pressure (bottom). The red solid line represents the median with the red dashed representing the standard deviation.

For WS1403 the sensors show a median difference of -0.000128 mS/cm and a standard deviation of 0.0077 mS/cm. Both sensors showed reasonable values for the residuals. The primary sensor, s/n 1701, was used for all the final data values (Figure 7). After data reduction 42 data points (95.45 %) were used in the final calculations.

For WS1409 the sensors show a median difference of -0.0033 mS/cm and a standard deviation of 0.046 mS/cm. Both sensors showed reasonable values for the residuals. The secondary sensor, s/n 2973, was used for all the final data values (Figure 7). After data reduction 34 data points (75.56 %) were used in the final calculations.

For WS1414 the sensors show a median difference of -0.0035 mS/cm and a standard deviation of 0.0073 mS/cm. Both sensors showed reasonable values for the residuals. The secondary sensor, s/n 2973, was used for all the final data values (Figure 7). After data reduction 40 data points (90.41 %) were used in the final calculations.

For WS1419 the sensors show a median difference of -0.0054 mS/cm and a standard deviation of 0.0051 mS/cm. Both sensors showed reasonable values for the residuals. The secondary sensor, s/n 2973, was used for all the final data values (Figure 7). After data reduction 41 data points (91.11 %) were used in the final calculations.

In order to calibrate the CTD conductivity data against the sample conductivity we assume a constant additive correction (offset), multiplicative correction (slope), time drift correction (represented by station number) and where needed, a linear pressure-dependent term. A non-linear function is used to derive these coefficients and are applied to

$$C_{new} = [m * C_{CTD} + (p_1 * station) + b + pcor * P]$$

where C_{bottle} is bottle conductivity (S/m), C_{CTD} is pre-cruise calibrated CTD conductivity (S/m), m is the conductivity slope, b is the offset (S/m), P is the pressure, $pcor$ is the pressure correction coefficient, $station$ is the station number and p_1 is the polynomial coefficient. The fit is also weighted in such way that the final solution is preferentially forced to fit the data below a specified depth, in this case 1000 dbar. Final calibration coefficients are listed in Table 16.

WS1403	WS1409	WS1414	WS1419
s/n 1335	s/n 2973	s/n 2973	s/n 2973
m= 1.0007659	m= 1.0001860	m= 0.9995158	m= 0.9997684
p_1= 0	p_1= 0	p_1= 0	p_1= 0
b= -0.0266368	b= -0.0091633	b= 0394856	b= 0.0140641
$pcor$= 5.261509e-06	$pcor$= 3.834936-06	$pcor$= -2.281211-05	$pcor$= -5.866492-06

Table 16: Conductivity calibration coefficients applied for final calibration.

For WS1403 the coefficients estimated by the equation above were then applied to the

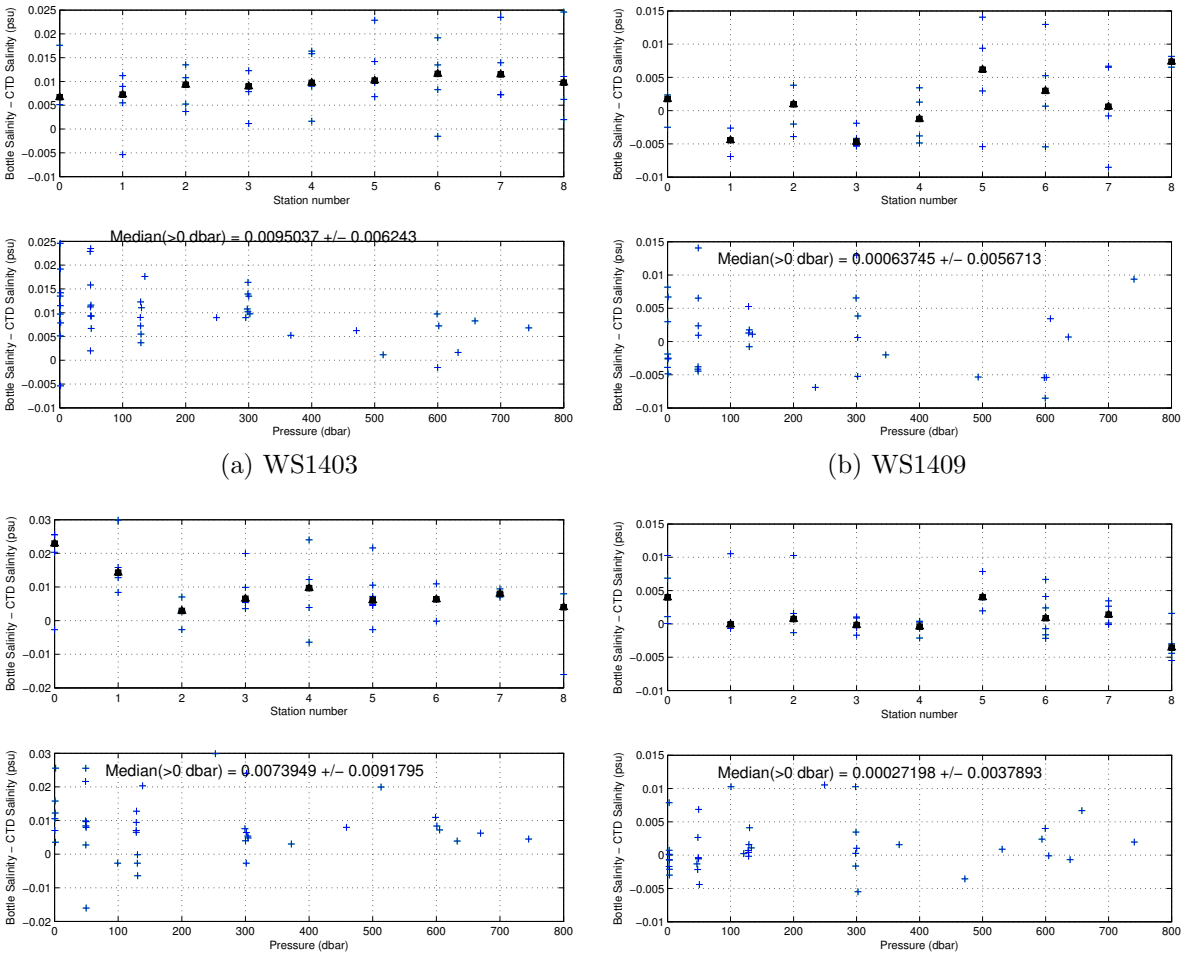
CTD conductivities and the final results (Figure 8 to Figure 9) show a residual of 6.9 · 10-5 psu and a standard deviation of 0.0057 psu.

For WS1409 the coefficients estimated by the equation above were then applied to the CTD conductivities and the final results (Figure 8 to Figure 9) show a residual of -2.9 · 10-4 psu and a standard deviation of 0.0056 psu.

For WS1414 the coefficients estimated by the equation above were then applied to the CTD conductivities and the final results (Figure 8 to Figure 9) show a residual of -1.8 · 10-4 psu and a standard deviation of 0.0063 psu.

For WS1419 the coefficients estimated by the equation above were then applied to the CTD conductivities and the final results (Figure 8 to Figure 9) show a residual of -6.7 · 10-4 psu and a standard deviation of 0.0036 psu.

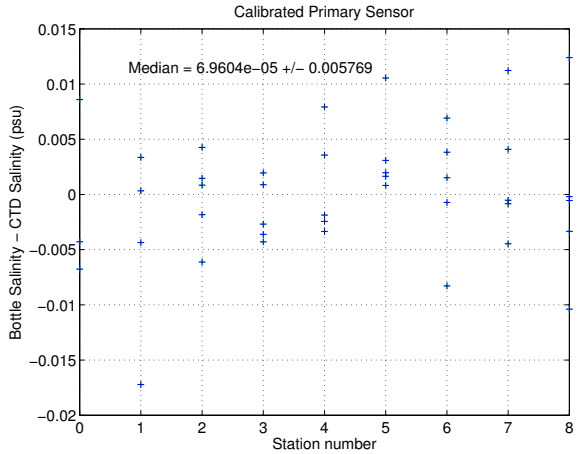
A final verification about the quality of the data was made by comparing the results of this cruise with some historical data (Figure 10 & 11).



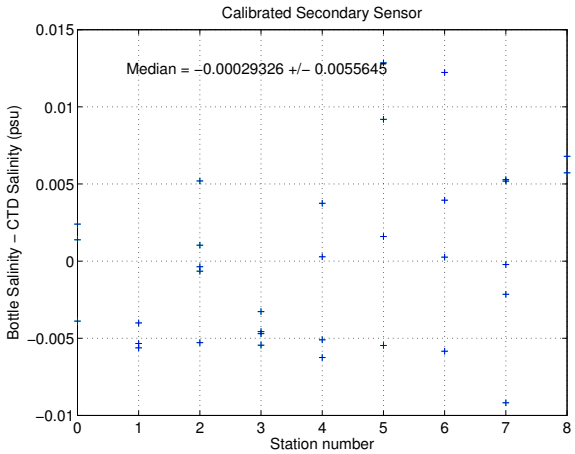
(a) WS1403 (b) WS1409

(c) WS1414 (d) WS1419

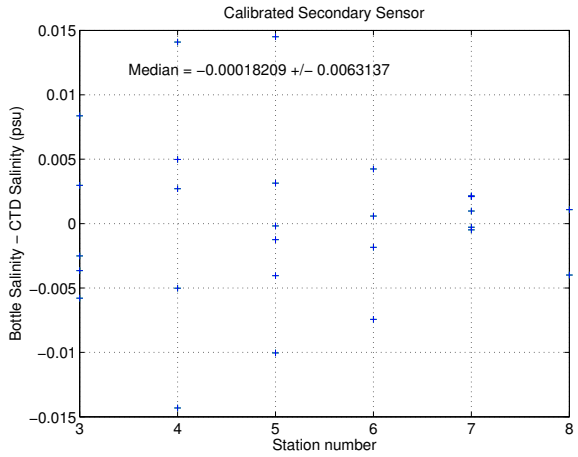
Figure 7: Bottle and uncalibrated CTD salinity differences plotted against pressure. The green crosses represent all data points and the blue are the data points below 1000 dbar. The median was calculated using only the data below 1000 dbar.



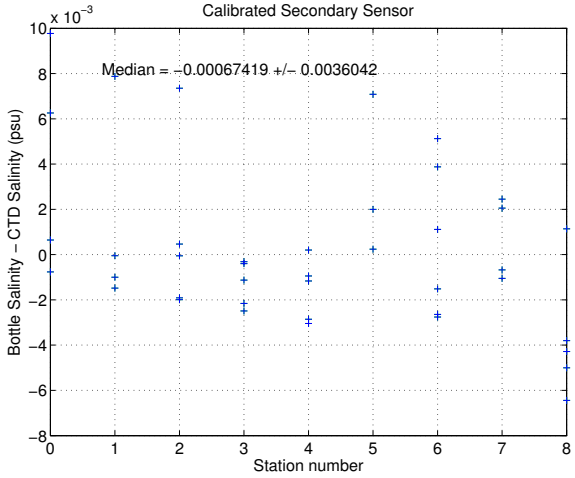
(a) WS1403



(b) WS1409

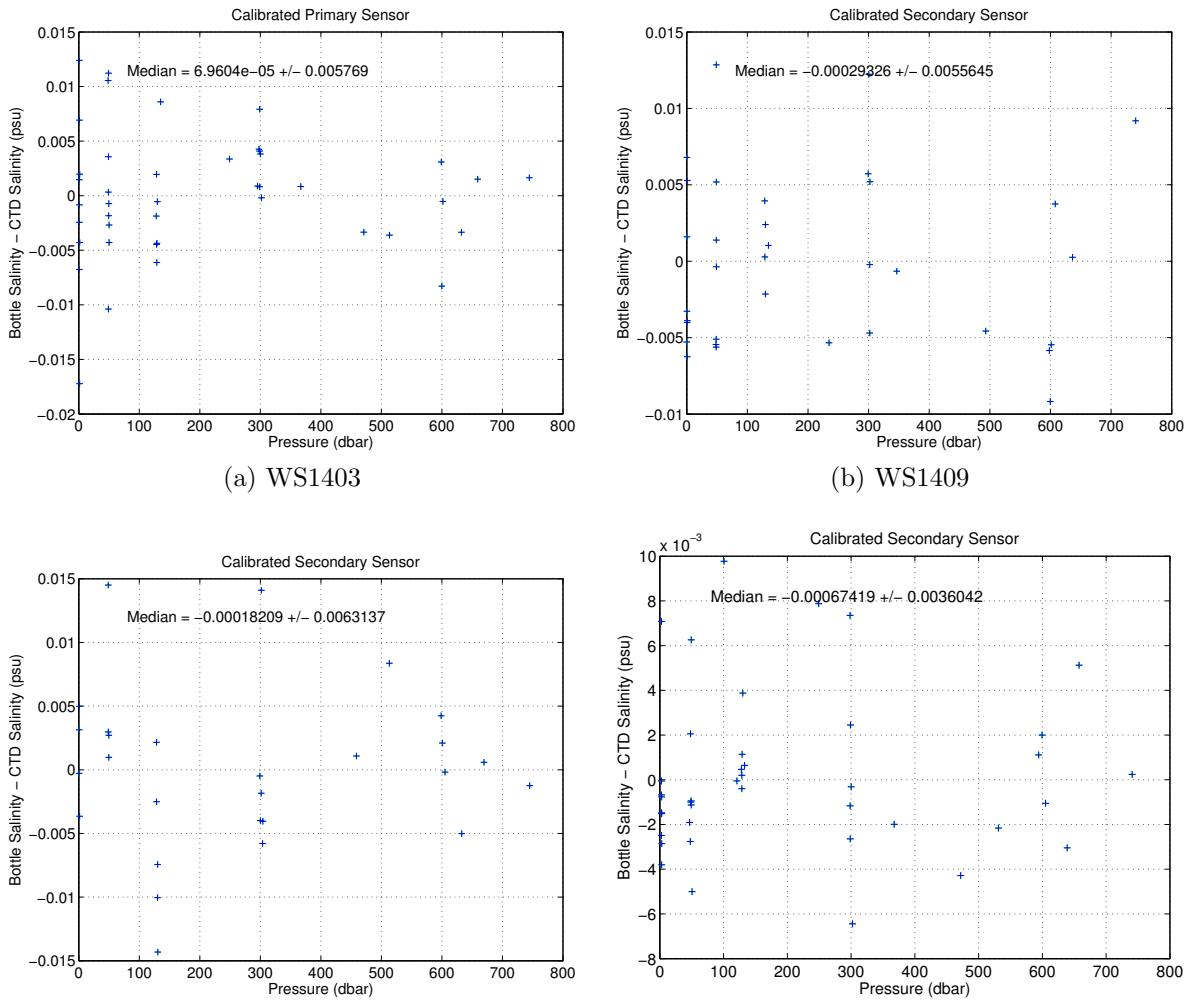


(c) WS1414



(d) WS1419

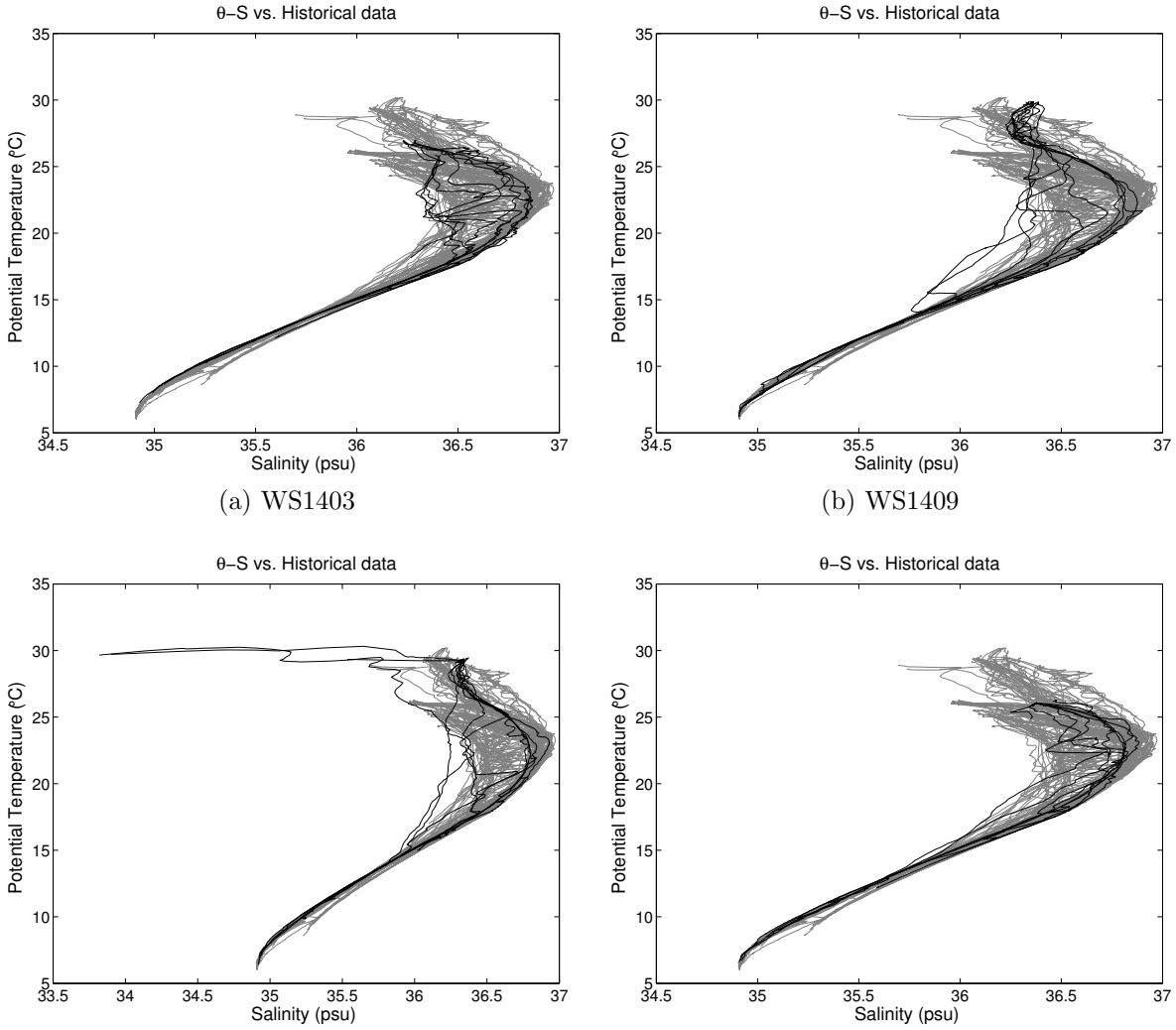
Figure 8: Bottle and calibrated CTD salinity differences plotted vs. station.



(a) WS1403 (b) WS1409

(c) WS1414 (d) WS1419

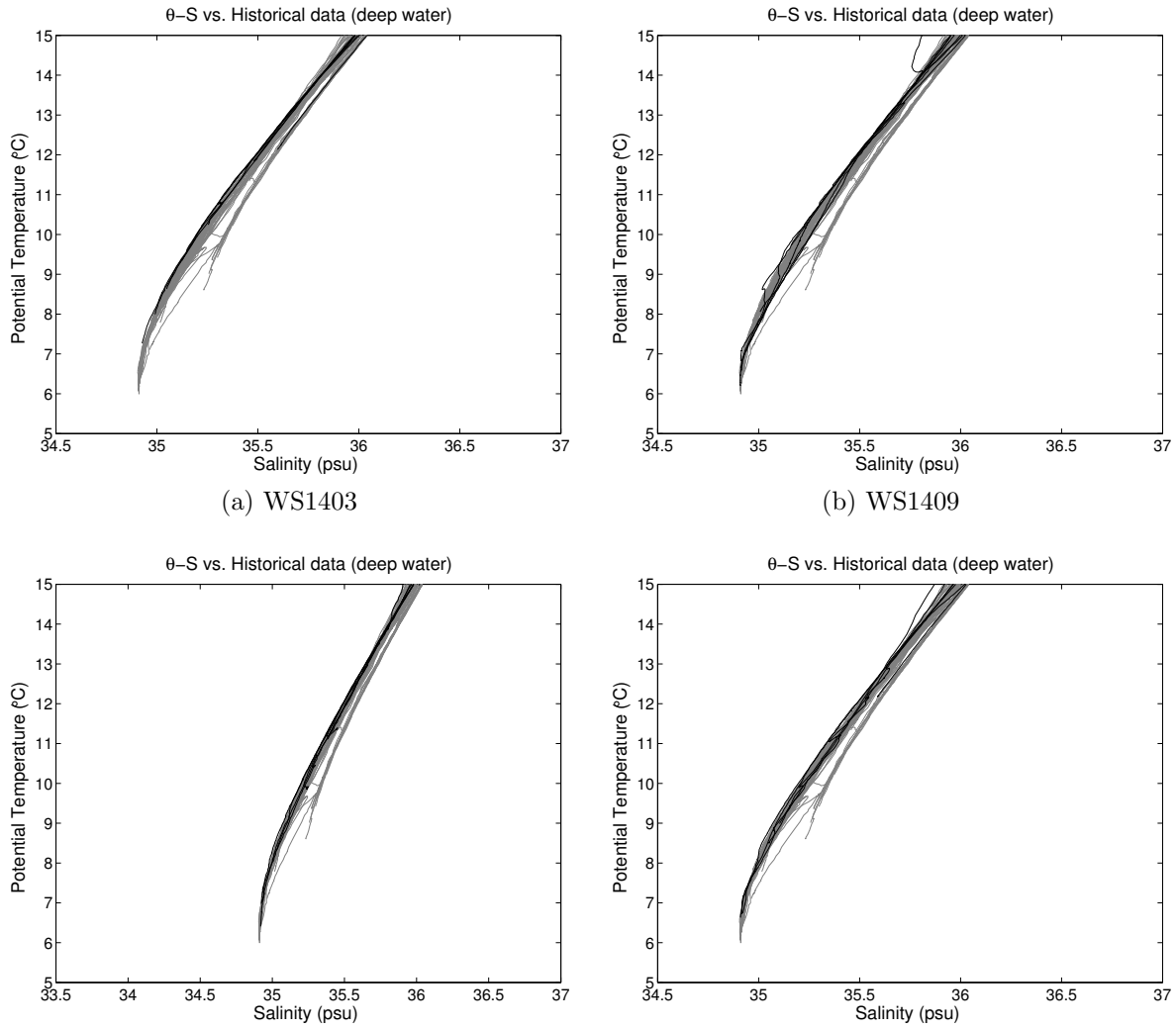
Figure 9: Bottle and calibrated CTD salinity differences plotted vs. pressure.



(a) WS1403 (b) WS1409

(c) WS1414 (d) WS1419

Figure 10: Potential Temperature - Salinity diagram for all stations. The solid black lines are the data collected during this cruise; the solid gray lines are data from the historical database.



(a) WS1403

(b) WS1409

(c) WS1414

(d) WS1419

Figure 11: Potential Temperature - Salinity diagram for all stations. The solid black lines are the data collected during this cruise; the solid gray lines are data from the historical database.

4.5 Dissolved Oxygen

Three SBE43 dissolved O_2 (DO) sensors were used these four cruises (Table 5). Due to a hysteresis problem with the oxygen sensors the DO sensors were calibrated to dissolved O2 check samples by matching the up cast bottle trips to down cast CTD data along neutral density surfaces, calculating CTD dissolved O_2, and then minimizing the residuals using a non-linear least-squares fitting procedure.

The algorithm used for converting oxygen sensor current and probe temperature measurements as described, requires a non-linear least squares regression technique in order to determine the best fit coefficients of the model for oxygen sensor behavior to the water sample observations. A Matlab® sub-routine called `oxfit.m` from the AOML CTD/CAL TOOLBOX performs a non-linear least squares regression using the Gauss-Newton algorithm with Levenberg-Marquardt modifications for global convergence. This algorithm is independent of the first coefficients guess and demonstrates excellent convergence. This `oxfit.m` routine includes an optional time drift term (related with the station number), allowing all stations to be calibrated without breaking into discrete groupings. The Owens and Millard (1985) algorithm was modified as follows:

$$O\ (ml/l) = \{Soc * (V + V_{offset} + tau(T,S) * \frac{\delta v}{\delta t}) + p1 * station\}$$
$$*(1.0 + A * T + B * T^2 + C * T^3) * OXSAT(T,S) * e^{E*(\frac{P}{K})}$$

with

	WS1403 S/N 1266	WS1409 S/N 1348	WS1414 S/N 1348	WS1419 S/N 1348
Soc	0.3936972	0.3402633	0.3436758	0.3788861
V_offset	-0.4751639	-0.5439388	-0.4835133	-0.5649624
tau	0.57	-0.35	0.78	0.48
A	0.0028529	0.0065518	-0.0008339	-0.0016951
B	-0.0000589	-0.0003598	0.0000469	-0.0001852
C	0.0000009	0.0000074	-0.0000001	0.0000078
E	0.5710414	0.0505343	0.0375474	0.0391078
$p1$	0	0	0.0011398	0

where Soc, tau, V_{offset}, A, B, C, E and $p1$ are the calibration coefficients shown above and V is the instrument voltage (V). T, S and P are the temperature, salinity and pressure measured by the CTD. K is the temperature in the absolute scale, $station$ is the station number, and $OXSAT$ is the oxygen saturation.

For WS1403 a comparison between the primary and secondary sensors (Figure 12) was evaluated. The sensors show a median difference of -1.69 $umol/kg$ and a standard deviation

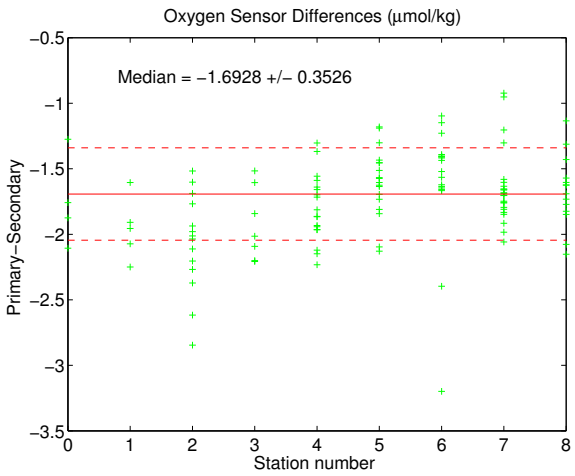
of 0.35 $umol/kg$. The primary sensor, s/n 1266, was used for all the final data values (Figure 13). After data reduction 50 data points (92.59%) were used in the final calculations. By minimizing the differences between the oxygen samples and the CTD oxygen estimated from the equation described in this section, the new coefficients above were calculated and then applied to the CTD original data (Figure 14 to Figure **??**). The residual is -0.11 $umol/kg$ and the standard deviation 1.17 $umol/kg$.

For WS1409 a comparison between the primary and secondary sensors (Figure 12) was evaluated. The sensors show a median difference of 0.61 $umol/kg$ and a standard deviation of 13.64 $umol/kg$. The secondary sensor, s/n 1348, was used for all the final data values (Figure 13). After data reduction 50 data points (90.91%) were used in the final calculations. By minimizing the differences between the oxygen samples and the CTD oxygen estimated from the equation described in this section, the new coefficients above were calculated and then applied to the CTD original data (Figure 14 to Figure **??**). The residual is -0.0098 $umol/kg$ and the standard deviation 1.09 $umol/kg$.

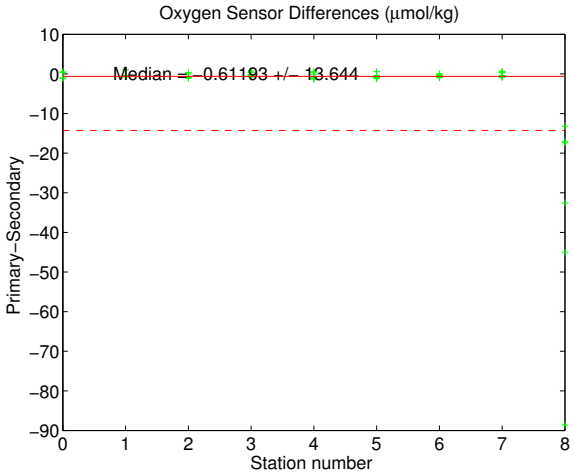
For WS1414 a comparison between the primary and secondary sensors (Figure 12) was evaluated. The sensors show a median difference of -0.56 $umol/kg$ and a standard deviation of 0.47 $umol/kg$. The secondary sensor, s/n 1348, was used for all the final data values (Figure 13). After data reduction 57 data points (100%) were used in the final calculations. By minimizing the differences between the oxygen samples and the CTD oxygen estimated from the equation described in this section, the new coefficients above were calculated and then applied to the CTD original data (Figure 14 to Figure **??**). The residual is 0.036 $umol/kg$ and the standard deviation 1.83 $umol/kg$.

For WS1419 a comparison between the primary and secondary sensors (Figure 12) was evaluated. The sensors show a median difference of -4.11 $umol/kg$ and a standard deviation of 0.73 $umol/kg$. The secondary sensor, s/n 1348, was used for all the final data values (Figure 13). After data reduction 52 data points (92.86%) were used in the final calculations. By minimizing the differences between the oxygen samples and the CTD oxygen estimated from the equation described in this section, the new coefficients above were calculated and then applied to the CTD original data (Figure 14 to Figure **??**). The residual is 0.036 $umol/kg$ and the standard deviation 1.48 $umol/kg$.

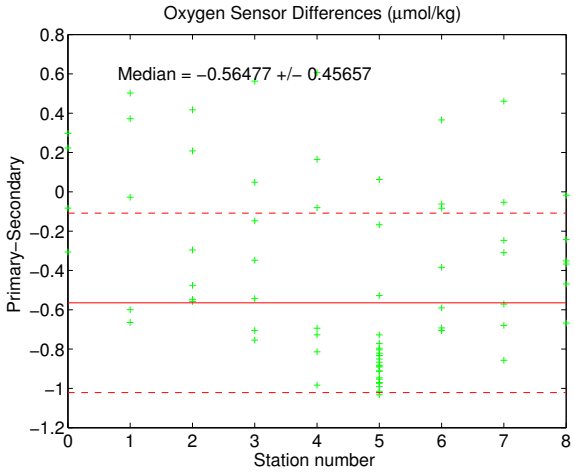
A final verification about the quality of the data, like in the salinity data, was made by comparing the results of this cruise with some historical data available at the location of the Florida Straits section (Figure 16 & 17).



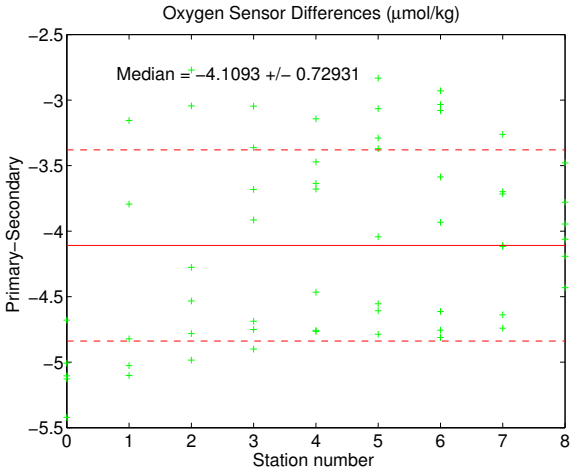
(a) WS1403



(b) WS1409

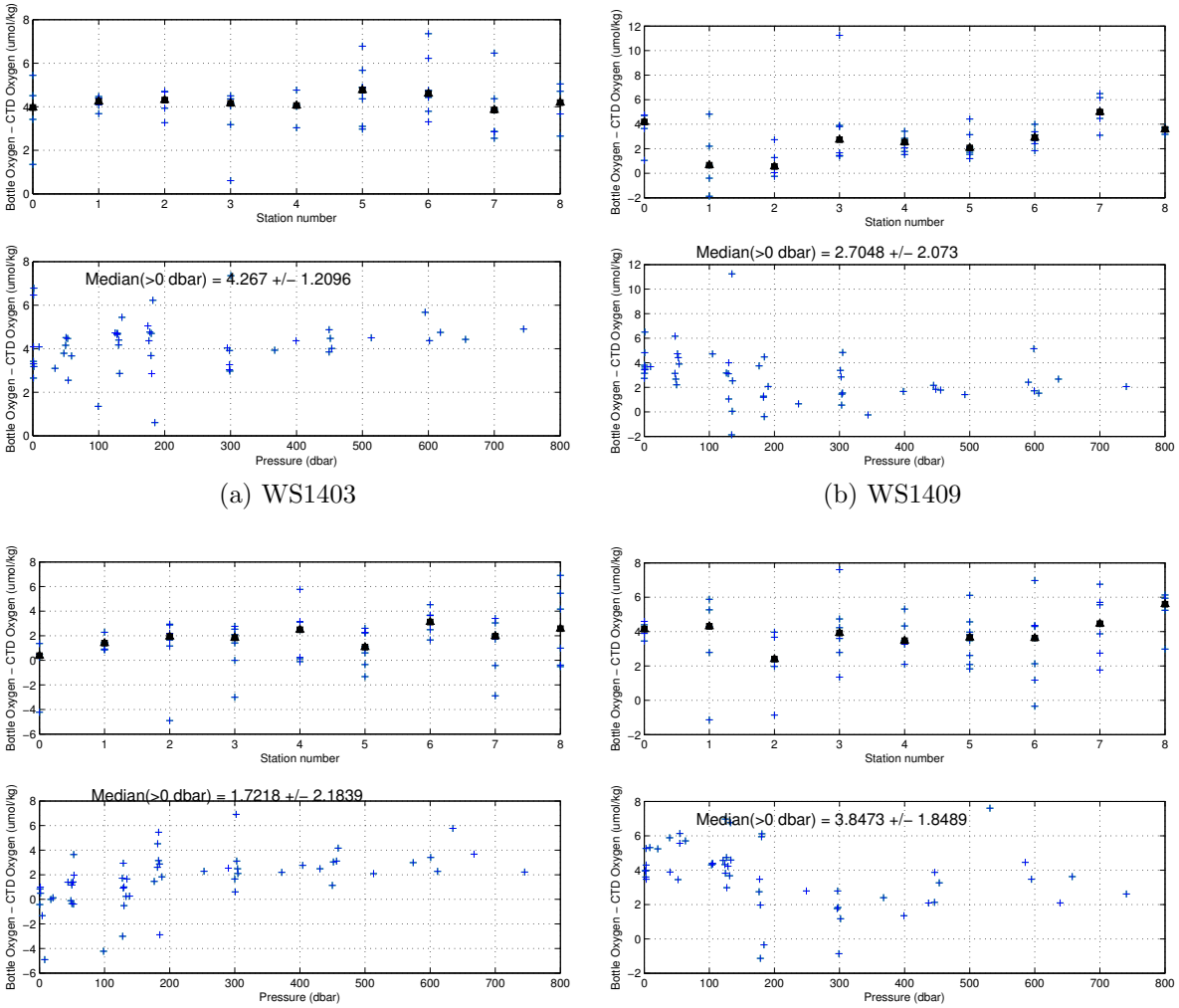


(c) WS1414



(d) WS1419

Figure 12: Dissolved oxygen differences between sensors by station (top) and by pressure (bottom). The red solid line represents the median with the red dashed representing the standard deviation.



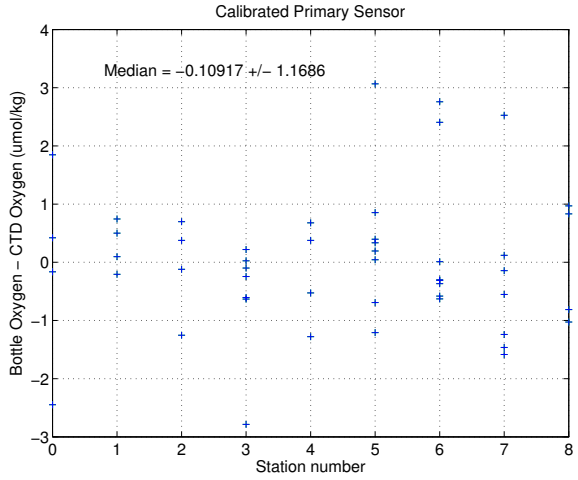
(a) WS1403

(b) WS1409

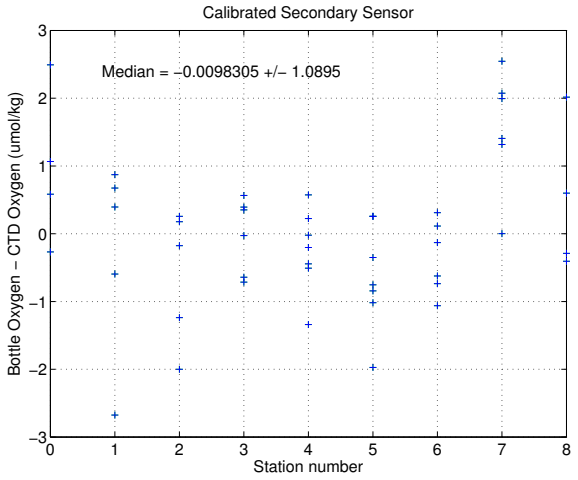
(c) WS1414

(d) WS1419

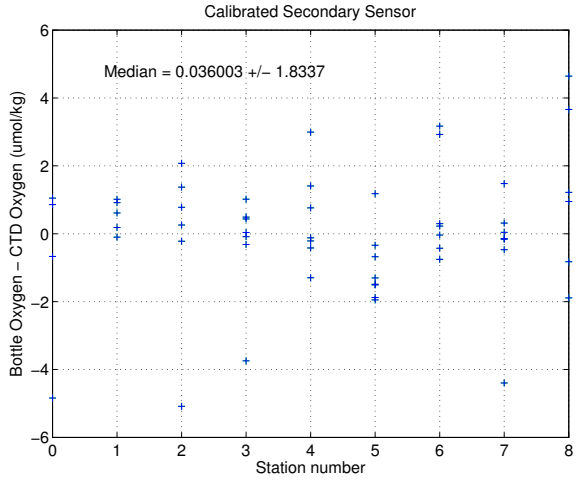
Figure 13: Bottle and uncalibrated CTD oxygen differences plotted against station number. The green crosses represent all data points and the blue are the data points below 1000 dbar. The median was calculated using only the data below 1000 dbar.



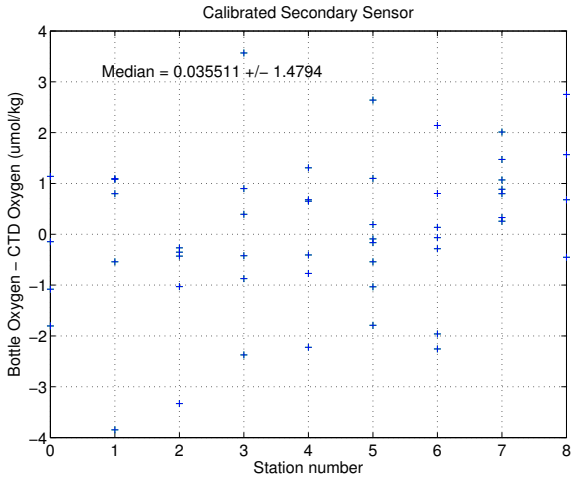
(a) WS1403



(b) WS1409

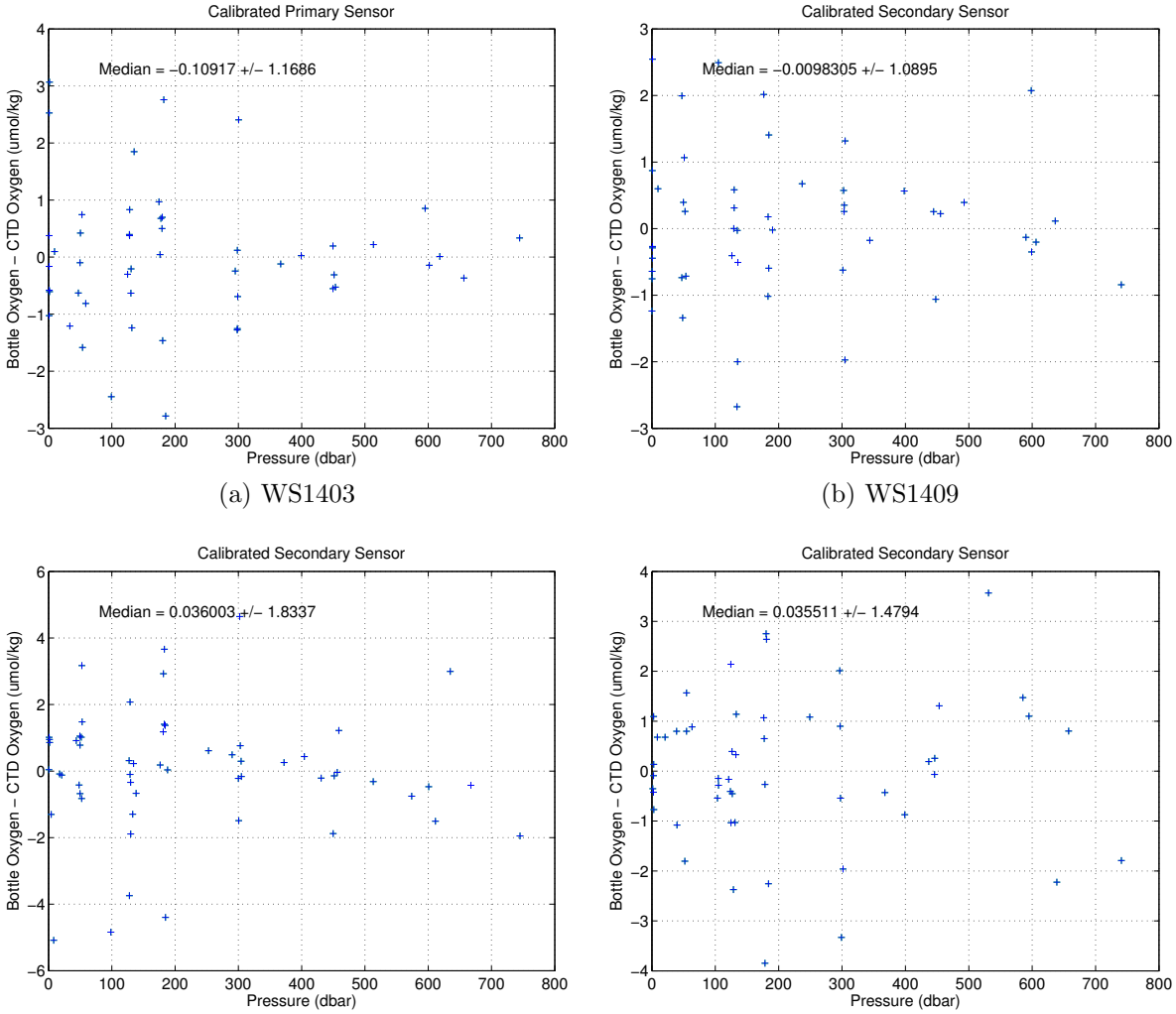


(c) WS1414



(d) WS1419

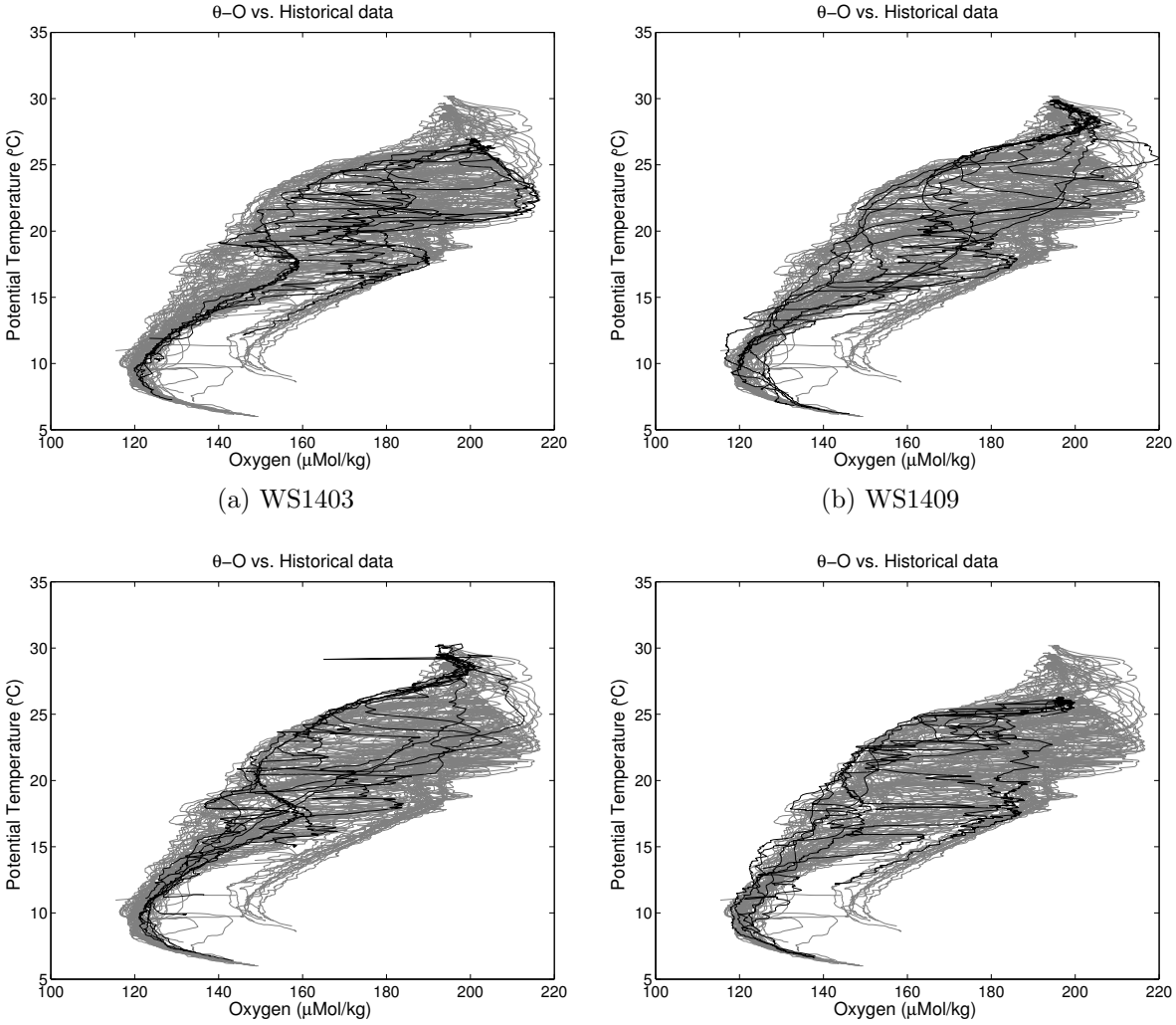
Figure 14: Bottle and calibrated CTD oxygen differences plotted vs. station.



(a) WS1403 (b) WS1409

(c) WS1414 (d) WS1419

Figure 15: Bottle and calibrated CTD oxygen differences plotted vs. pressure.



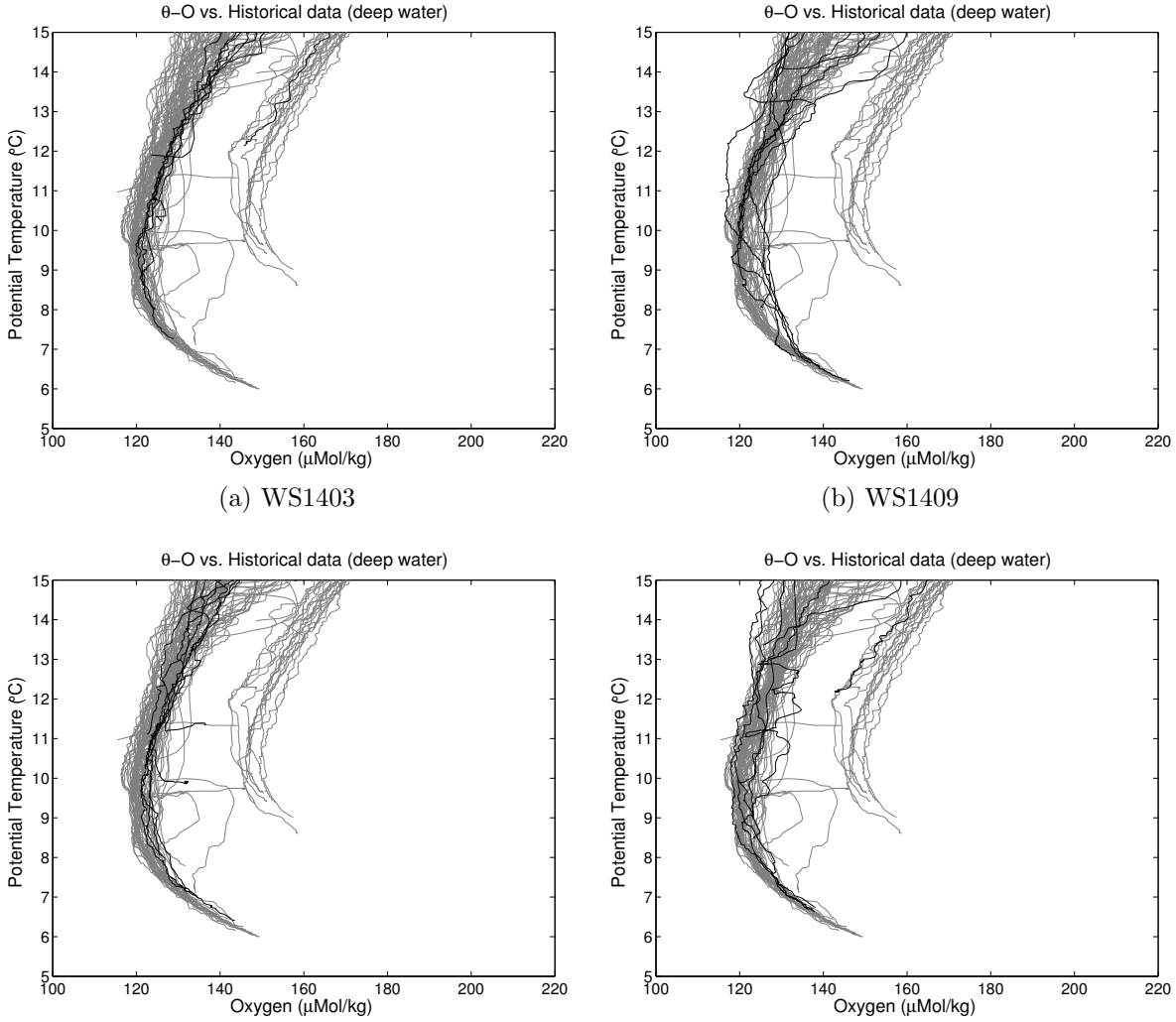
(a) WS1403

(b) WS1409

(c) WS1414

(d) WS1419

Figure 16: Potential Temperature - Oxygen diagram for all stations. The solid black lines are the data collected during this cruise; the solid gray lines are data from the historical database.



(a) WS1403

(b) WS1409

(c) WS1414

(d) WS1419

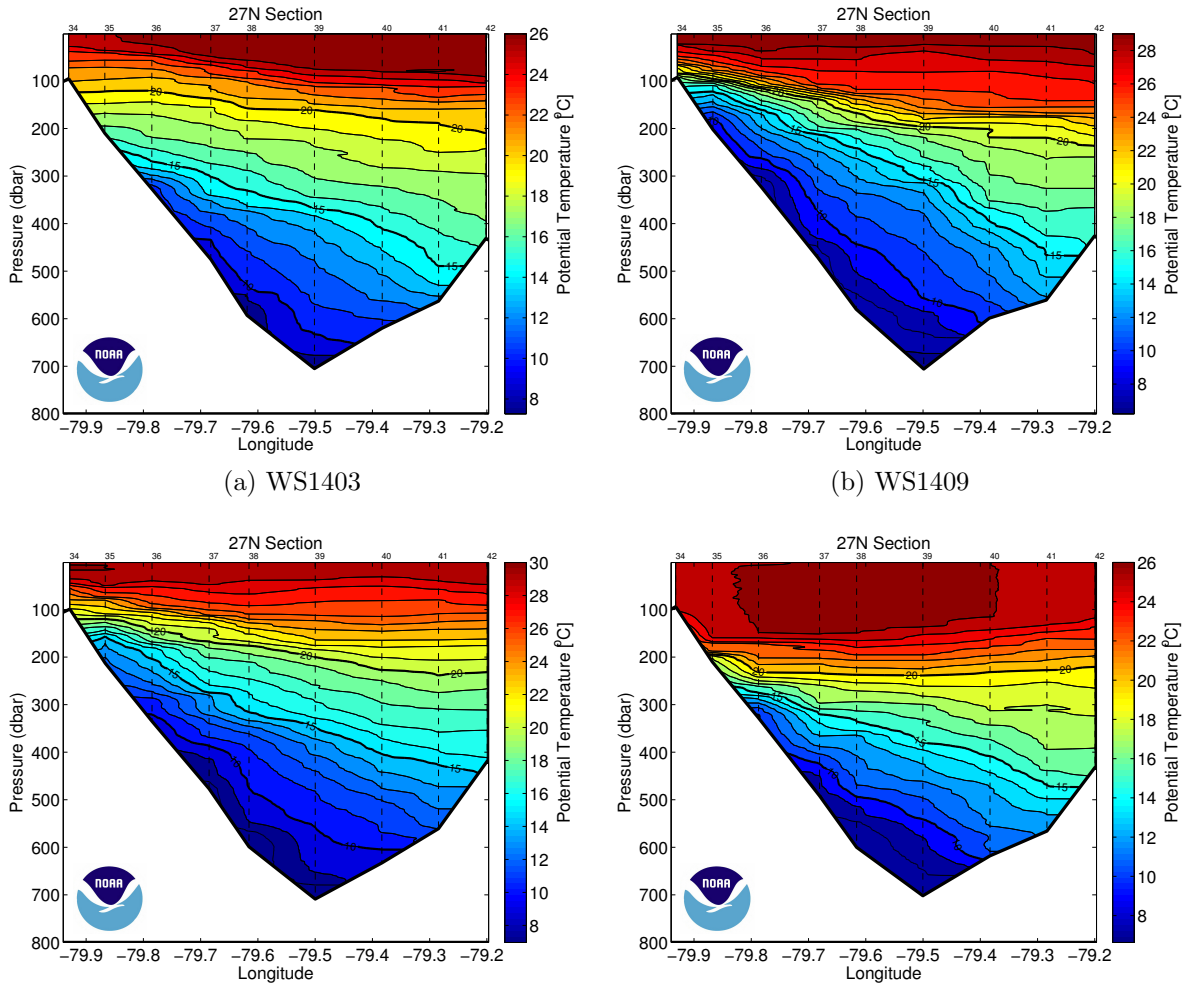
Figure 17: Potential Temperature - Oxygen diagram for all stations. The solid black lines are the data collected during this cruise; the solid gray lines are data from the historical database.

5 Final CTD Data Presentation

The final calibrated data files were used to produce the tables and station profile plots presented in Appendix A for each CTD station. The table on the top is in "standard depths" followed by the a table of the bottle trip depths. The corresponding profile plot is shown on the following page. Niskin bottle depths are presented on the right side of the profile plot. Bottle salinity and oxygen values are plotted as points in the three smaller plots.

Vertical sections of potential temperature, CTD salinity, potential density, and CTD oxygen are contoured with pressure as the vertical axis. The Florida Current Section uses longitude as the horizontal axis (Figure 18 to Figure 21).

Post-cruise calibrations were applied to CTD data associated with bottle data using Matlab sub-routines (`apply_calibration.m`). WOCE quality flags were appended to bottle data records. "Bad values" (WOCE quality control value = 4) were flagged if the bottle samples failed the initial quality control and were not used for the calibration (which meant they typically fell outside 2.57 standard deviations of the difference between samples and uncalibrated CTD values). A second pass is applied, using the value of 2.5 times the standard deviation of the difference between calibrated CTD values and bottle samples, where bottle values may be flagged as "bad values" or as questionable (WOCE quality control value = 3).



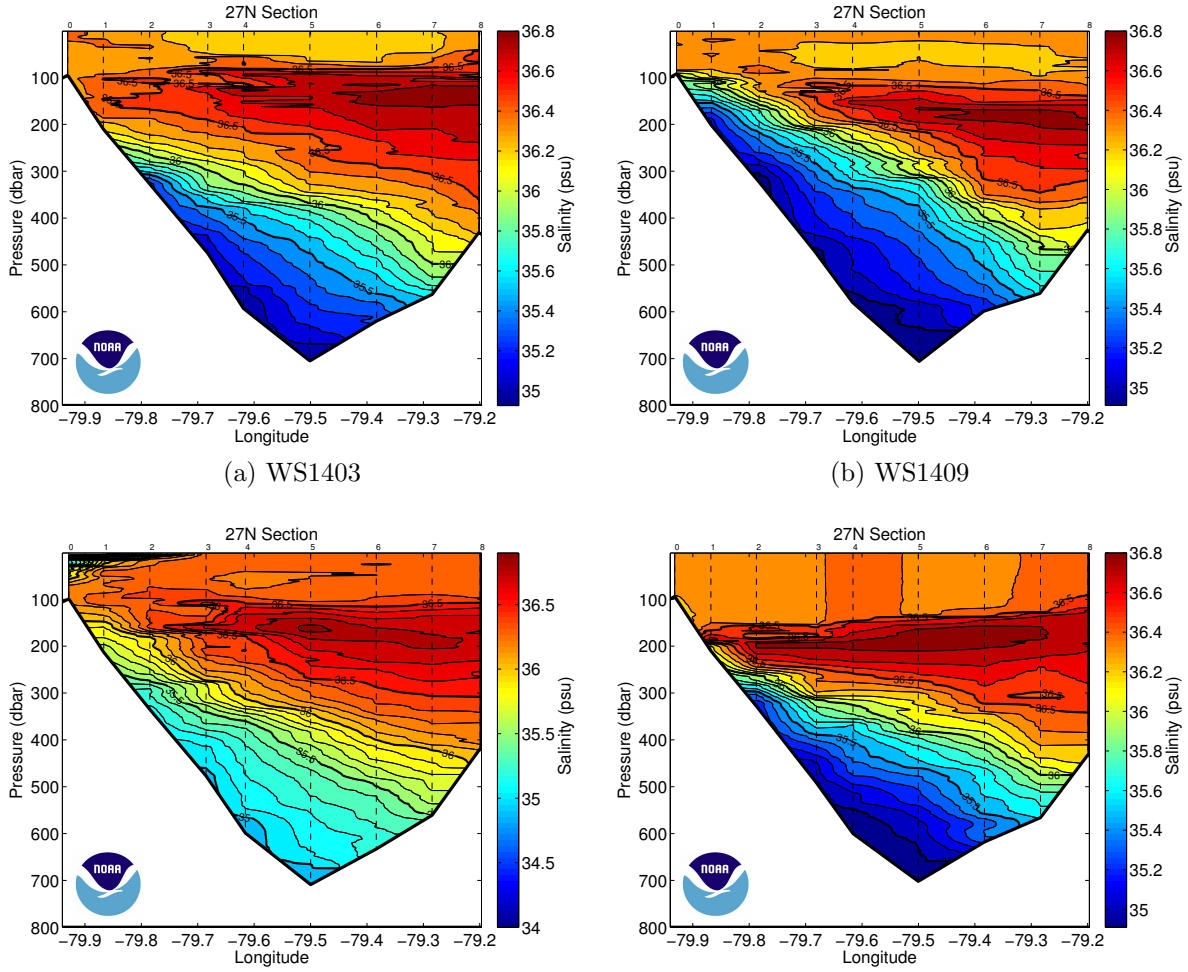
(a) WS1403

(b) WS1409

(c) WS1414

(d) WS1419

Figure 18: Potential Temperature (°C) section for the Florida Current North section. Dashed vertical lines are the CTD station locations.



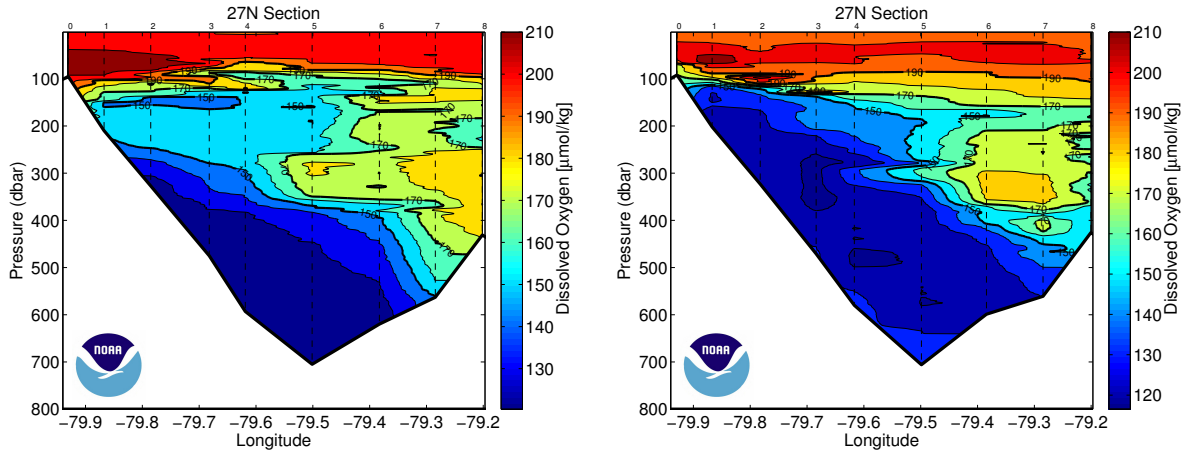
(a) WS1403

(b) WS1409

(c) WS1414

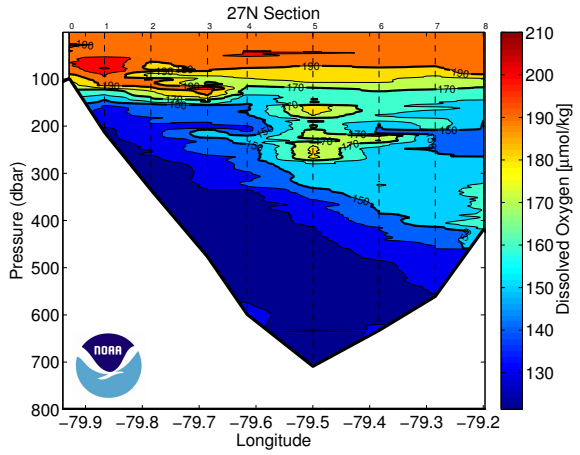
(d) WS1419

Figure 19: Salinity (PSS 78) section for the Florida Current North section. Dashed vertical lines are the CTD station locations.

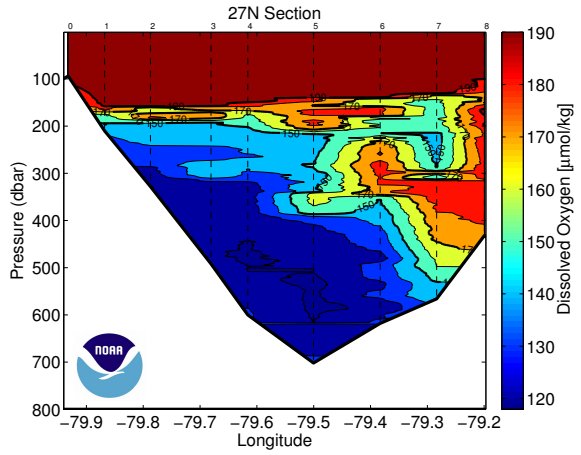


(a) WS1403

(b) WS1409

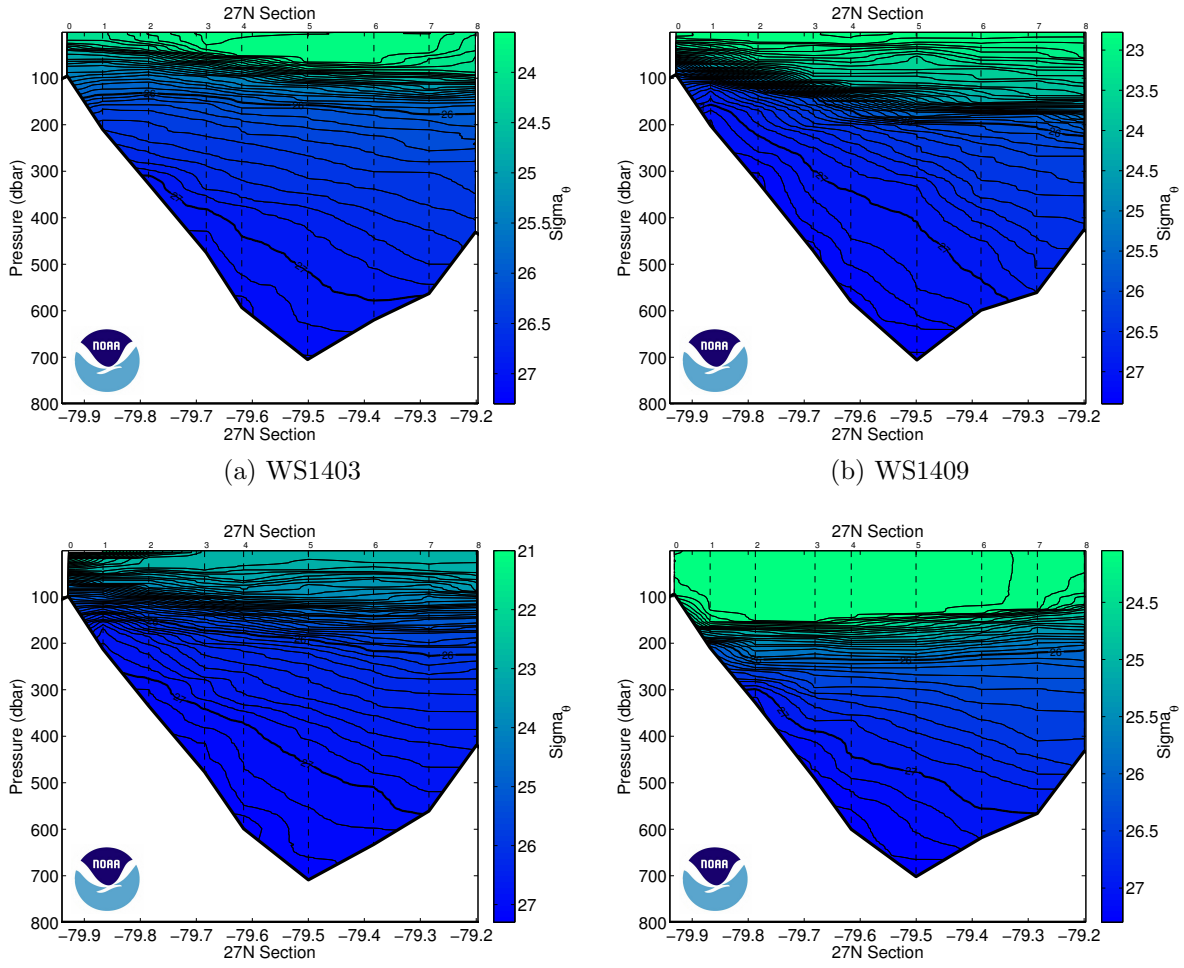


(c) WS1414



(d) WS1419

Figure 20: Dissolved Oxygen ($umol/kg$) section for the Florida Current North section. Dashed vertical lines are the CTD station locations.



(a) WS1403

(b) WS1409

(c) WS1414

(d) WS1419

Figure 21: Neutral density (kg/m3) section for the Florida Current North section. Dashed vertical lines are the CTD station locations.

6 Acknowledgements

The successful completion of the cruise relied on dedicated assistance from many individuals on shore and on the UNOLS ship Endeavor. Funded investigators in the project and members of the Western Boundary Time Series, and the RAPID/MOC programs were instrumental in planning and executing the cruise. The participants in the cruise showed dedication and camaraderie during their 17 days at sea. Officers and crew of the Endeavor exhibited a high degree of professionalism and assistance to accomplish the mission and to make us feel at home during the voyage.

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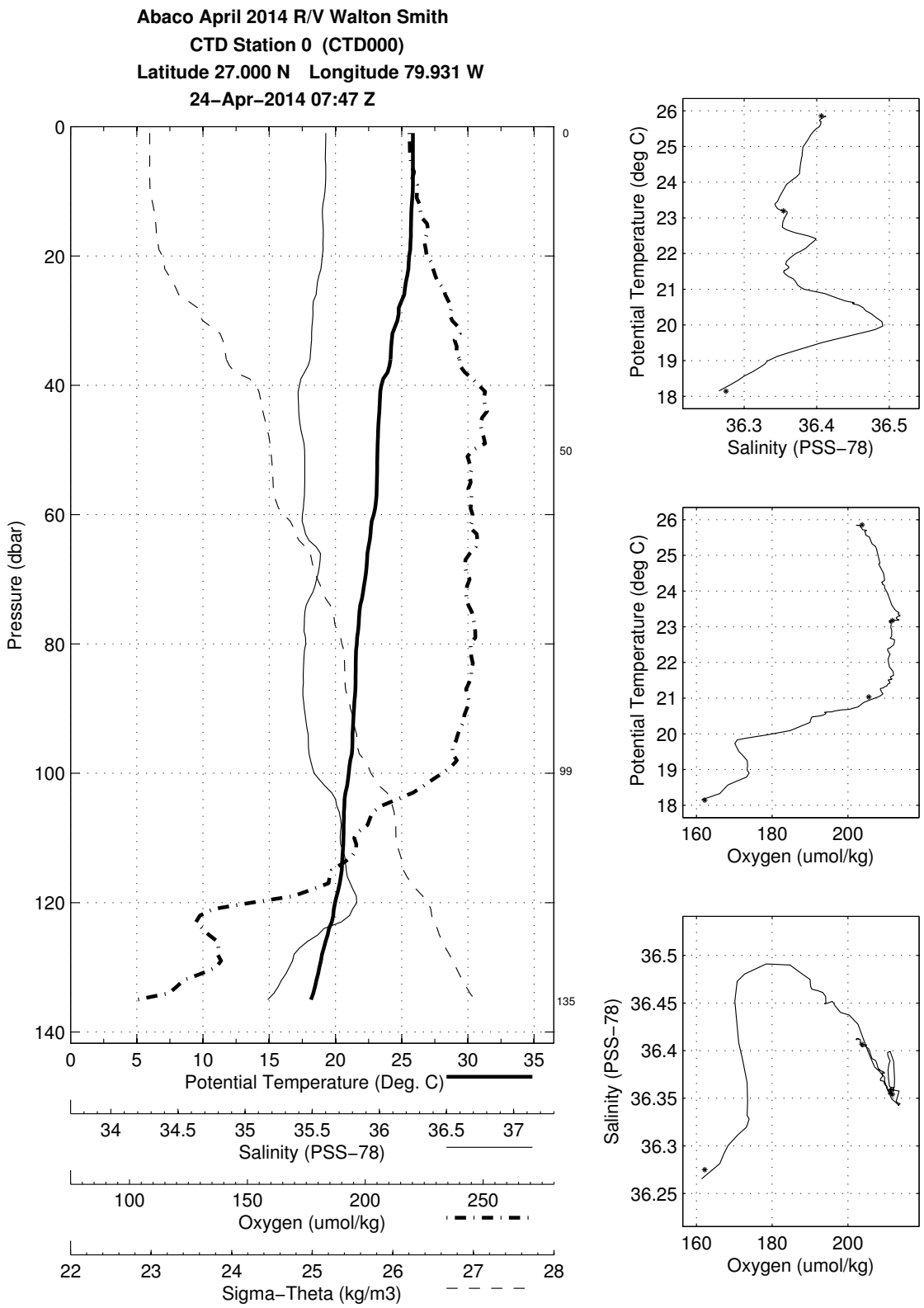
A Hydrographic - CTD Data

A.1 WS1403

Florida Straits April 2014 R/V Walton Smith
CTD Station 0 (CTD000)
Latitude 27.000N Longitude 79.931W
24-Apr-2014 07:47Z

Pressure dbar	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}	DynHt m^2·s^{-2}	SigT kg·m^{-3}
1	25.844	25.844	36.413	202.1	0.004	24.148
10	25.834	25.832	36.411	203.3	0.038	24.151
20	25.570	25.566	36.404	204.7	0.075	24.228
30	24.682	24.675	36.379	208.5	0.111	24.483
50	23.187	23.177	36.359	211.6	0.174	24.913
75	21.824	21.809	36.360	211.4	0.247	25.305
100	21.019	20.999	36.383	207.0	0.312	25.547
125	19.434	19.411	36.392	172.1	0.368	25.979

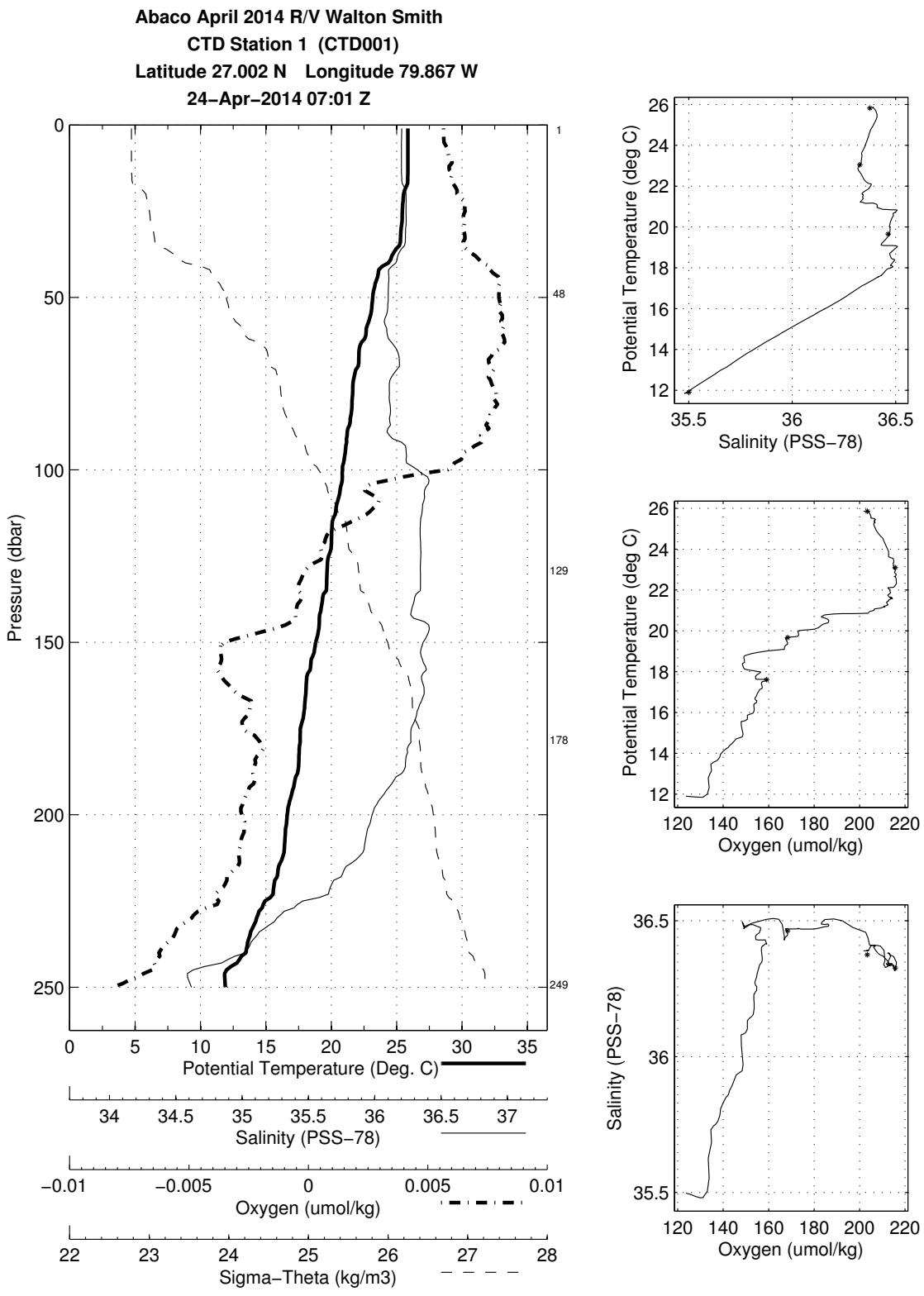
Pressure dbar	Niskin	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}
135	1	18.166	18.143	36.275	162.2
100	2	21.004	21.088	−999.000	NaN
50	3	23.206	23.196	36.354	211.7
1	4	25.854	25.854	36.407	203.7


Abaco April 2014 R/V Walton Smith
CTD Station 0 (CTD000)
Latitude 27.000 N Longitude 79.931 W
24−Apr−2014 07:47 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Potential Temperature (deg C)
Oxygen (umol/kg)
Salinity (PSS−78)
Oxygen (umol/kg)

Florida Straits April 2014 R/V Walton Smith
CTD Station 1 (CTD001)
Latitude 27.002N Longitude 79.867W
24-Apr-2014 07:01Z

Pressure	Temp90	PoTemp90	Salinity	Oxygen	DynHt	SigT
dbar	°C	°C	PSS-78	μmol·kg^{-1}	m^2·s^{-2}	kg·m^{-3}
1	25.860	25.859	36.391	201.8	0.004	24.127
10	25.859	25.856	36.390	203.7	0.038	24.127
20	25.532	25.528	36.409	204.9	0.075	24.244
30	25.346	25.340	36.408	206.3	0.112	24.301
50	23.184	23.173	36.334	214.8	0.179	24.895
75	21.674	21.659	36.338	213.1	0.250	25.331
100	20.878	20.858	36.458	202.7	0.314	25.643
125	19.818	19.795	36.472	173.2	0.370	25.939
150	18.835	18.808	36.482	150.1	0.420	26.203
200	16.668	16.635	36.265	154.2	0.503	26.573
250	11.933	11.900	35.498	123.5	0.570	26.995

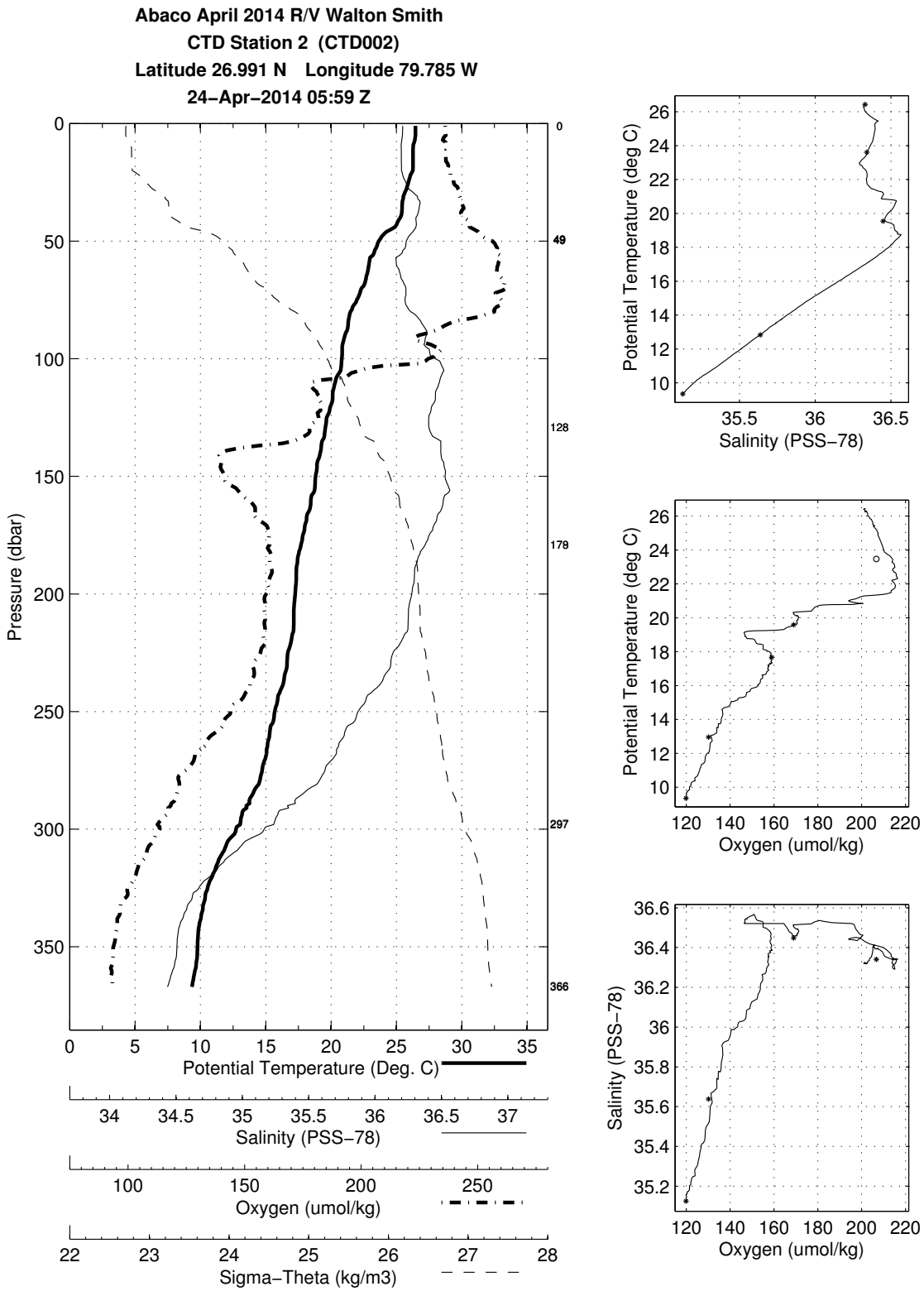
Pressure	Niskin	Temp90	PoTemp90	Salinity	Oxygen
dbar		°C	°C	PSS-78	μmol·kg^{-1}
249	1	11.943	11.910	35.501	NaN
178	2	17.655	17.834	−999.000	NaN
129	3	19.680	19.656	36.463	168.3
49	4	23.057	23.047	36.326	215.7
1	5	25.826	25.825	36.375	203.3


Abaco April 2014 R/V Walton Smith
CTD Station 1 (CTD001)
Latitude 27.002 N Longitude 79.867 W
24−Apr−2014 07:01 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Oxygen (umol/kg)

Florida Straits April 2014 R/V Walton Smith
CTD Station 2 (CTD002)
Latitude 26.991N Longitude 79.785W
24-Apr-2014 05:59Z

Pressure dbar	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}	DynHt m^2·s^{-2}	SigT kg·m^{-3}
1	26.450	26.450	36.326	201.4	0.004	23.892
10	26.274	26.272	36.319	202.0	0.040	23.943
20	26.252	26.248	36.320	202.4	0.080	23.952
30	25.596	25.589	36.389	205.2	0.118	24.210
50	23.658	23.648	36.345	213.0	0.188	24.764
75	21.983	21.968	36.338	215.2	0.263	25.244
100	20.832	20.813	36.494	197.3	0.325	25.683
125	19.686	19.663	36.459	170.6	0.380	25.965
150	18.835	18.809	36.543	147.6	0.428	26.250
200	17.284	17.251	36.372	157.7	0.512	26.508
250	15.720	15.680	36.098	149.1	0.589	26.666
300	12.762	12.721	35.618	131.8	0.656	26.928

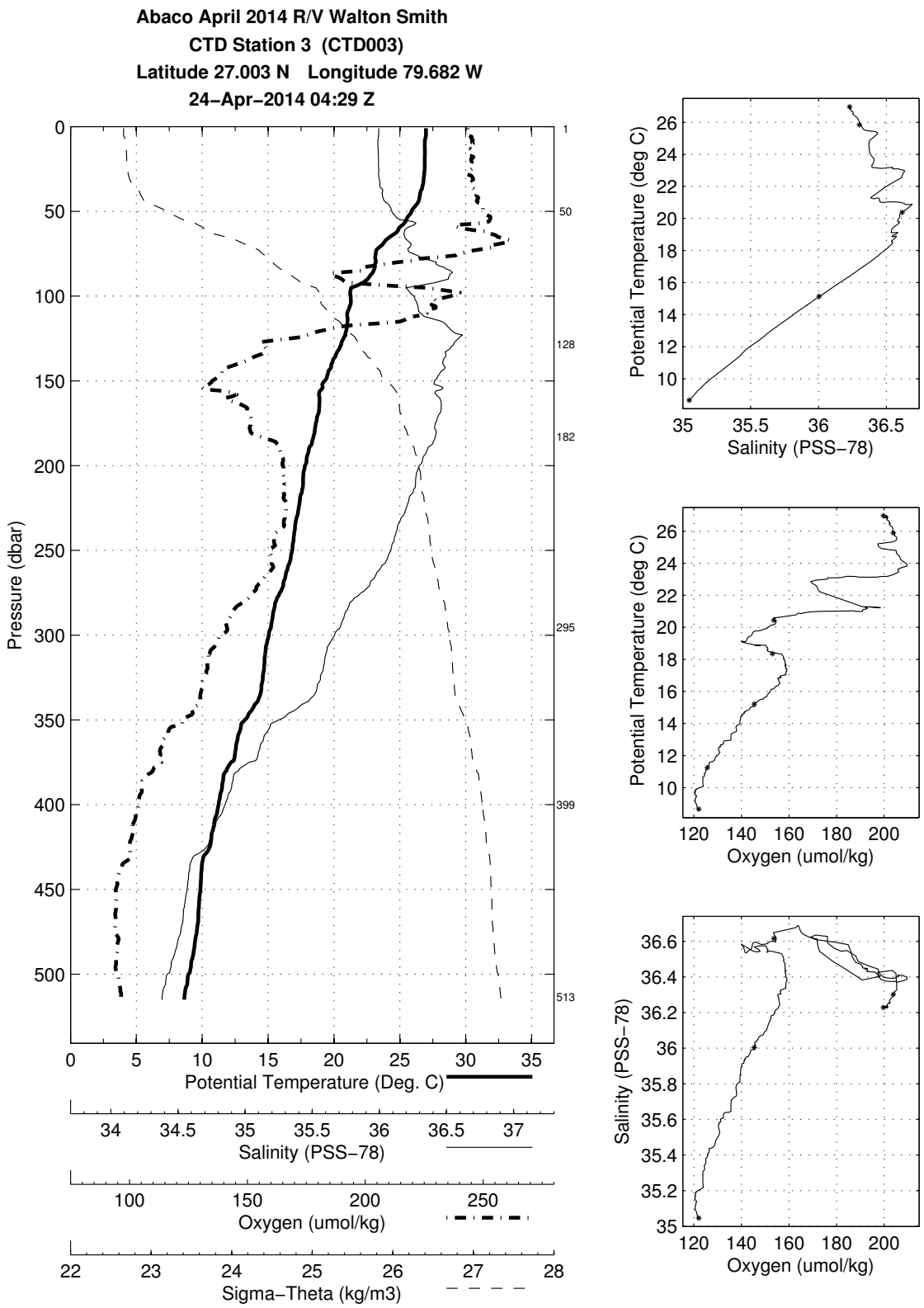
Pressure dbar	Niskin	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}
367	1	9.392	9.351	35.125	119.9
367	2	9.408	9.922	−999.000	NaN
298	3	12.877	12.836	35.638	130.1
298	4	12.869	13.237	−999.000	NaN
179	5	17.677	17.857	−999.000	NaN
179	6	17.687	17.866	−999.000	NaN
129	7	19.570	19.546	36.448	169.0
129	8	19.569	19.687	−999.000	NaN
49	9	23.619	23.608	36.341	206.7
49	10	23.616	23.651	−999.000	NaN
49	11	23.628	23.664	−999.000	NaN
49	12	23.616	23.651	−999.000	NaN
1	13	26.431	26.431	36.330	NaN
1	14	26.431	26.432	−999.000	NaN


Abaco April 2014 R/V Walton Smith
CTD Station 2 (CTD002)
Latitude 26.991 N Longitude 79.785 W
24−Apr−2014 05:59 Z
Pressure (dbar)
0
50
100
150
200
250
300
350
0
49
128
179
297
366
0 5 10 15 20 25 30 35
Potential Temperature (Deg. C)
34 34.5 35 35.5 36 36.5 37
Salinity (PSS−78)
100 150 200 250
Oxygen (umol/kg)
22 23 24 25 26 27 28
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
10 12 14 16 18 20 22 24 26
35.5 36 36.5
Salinity (PSS−78)
Potential Temperature (deg C)
10 12 14 16 18 20 22 24 26
120 140 160 180 200 220
Oxygen (umol/kg)
Salinity (PSS−78)
35.2 35.4 35.6 35.8 36 36.2 36.4 36.6
120 140 160 180 200 220
Oxygen (umol/kg)

Florida Straits April 2014 R/V Walton Smith
CTD Station 3 (CTD003)
Latitude 27.003N Longitude 79.682W
24-Apr-2014 04:29Z

Pressure dbar	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}	DynHt m^2·s^{-2}	SigT kg·m^{-3}
1	26.985	26.985	36.234	200.1	0.004	23.652
10	26.895	26.892	36.229	201.3	0.042	23.678
20	26.892	26.887	36.232	201.0	0.084	23.682
30	26.823	26.817	36.234	201.2	0.126	23.706
50	25.889	25.878	36.306	204.0	0.208	24.057
75	23.183	23.168	36.422	197.8	0.293	24.964
100	21.286	21.267	36.426	196.3	0.362	25.507
125	20.736	20.712	36.668	159.9	0.422	25.843
150	19.307	19.280	36.538	142.3	0.473	26.125
200	17.827	17.793	36.454	158.4	0.562	26.438
250	16.868	16.826	36.299	155.3	0.642	26.554
300	15.092	15.046	35.992	144.5	0.716	26.727
400	11.284	11.233	35.393	125.7	0.843	27.039
500	8.995	8.940	35.077	121.2	0.947	27.188

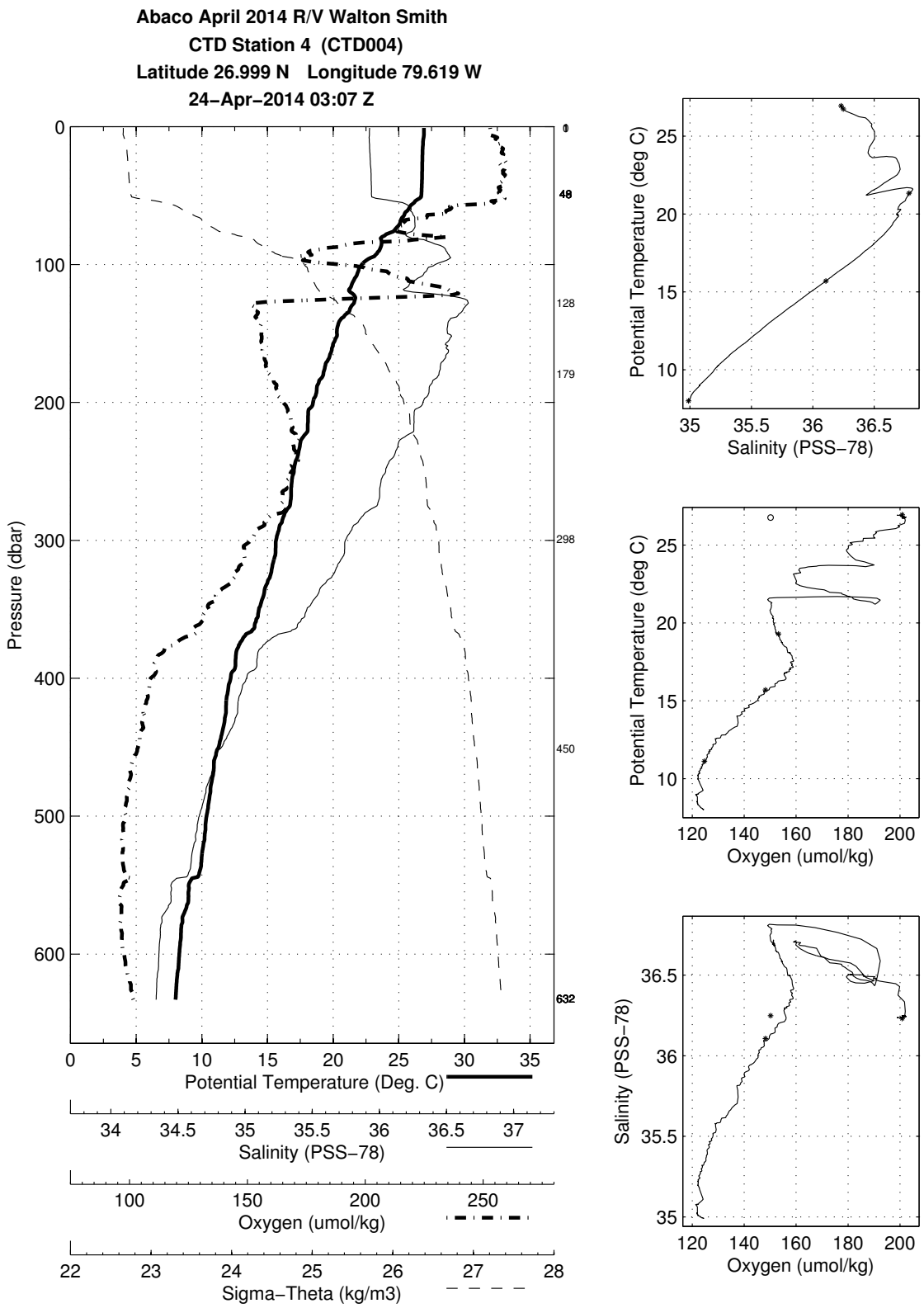
Pressure dbar	Niskin	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}
513	1	8.714	8.658	35.046	122.1
400	2	11.267	11.790	−999.000	NaN
295	3	15.185	15.139	36.004	145.4
183	4	18.360	18.536	−999.000	NaN
129	5	20.409	20.385	36.617	153.6
50	6	25.853	25.842	36.302	203.8
2	7	26.963	26.963	36.229	199.7


Abaco April 2014 R/V Walton Smith
CTD Station 3 (CTD003)
Latitude 27.003 N Longitude 79.682 W
24−Apr−2014 04:29 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Potential Temperature (deg C)
Oxygen (umol/kg)
Salinity (PSS−78)
Oxygen (umol/kg)

Florida Straits April 2014 R/V Walton Smith
CTD Station 4 (CTD004)
Latitude 26.999N Longitude 79.619W
24-Apr-2014 03:07Z

Pressure dbar	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}	DynHt m^2·s^{-2}	SigT kg·m^{-3}
1	26.918	26.918	36.238	199.0	0.004	23.677
10	26.862	26.860	36.236	201.1	0.042	23.694
20	26.811	26.806	36.241	201.8	0.084	23.715
30	26.794	26.787	36.245	202.1	0.126	23.724
50	26.723	26.712	36.250	201.3	0.209	23.752
75	24.702	24.685	36.493	179.4	0.301	24.566
100	22.208	22.188	36.621	167.8	0.375	25.397
125	21.702	21.677	36.795	167.1	0.438	25.674
150	20.313	20.284	36.694	151.2	0.492	25.978
200	18.505	18.470	36.550	155.8	0.587	26.342
250	17.052	17.010	36.332	157.5	0.670	26.535
300	15.694	15.646	36.096	148.9	0.746	26.672
400	12.246	12.193	35.519	128.1	0.881	26.955
500	10.426	10.365	35.243	122.9	0.996	27.078
600	8.344	8.280	35.007	122.5	1.098	27.237

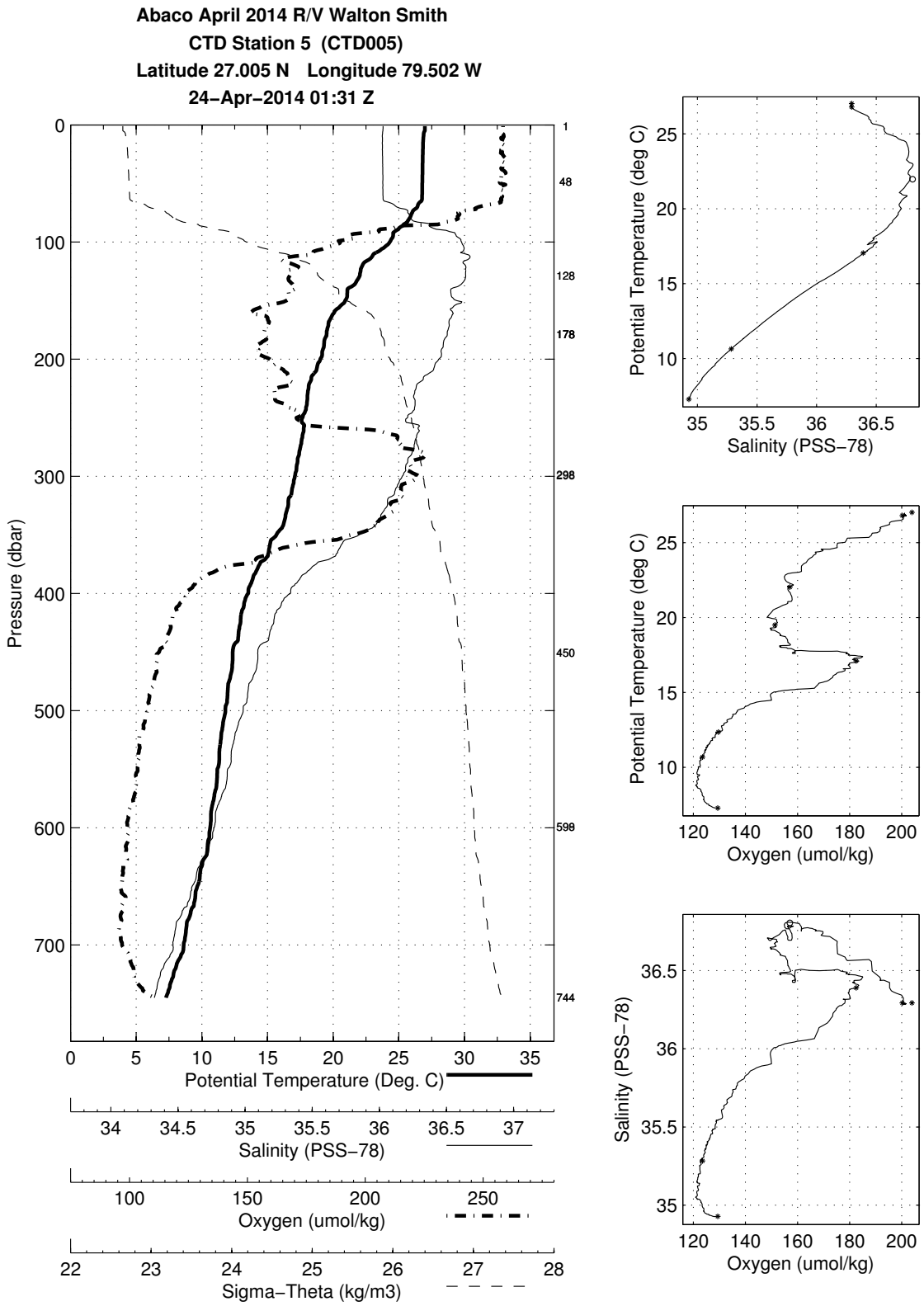
Pressure dbar	Niskin	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}
632	1	8.067	8.001	34.988	NaN
632	2	8.067	8.981	−999.000	NaN
632	3	8.067	8.981	−999.000	NaN
632	4	8.068	8.982	−999.000	NaN
632	5	8.068	8.982	−999.000	NaN
451	6	11.168	11.757	−999.000	NaN
299	7	15.741	15.693	36.107	148.2
179	8	19.289	19.454	−999.000	NaN
128	9	21.357	21.332	36.784	NaN
49	10	26.755	26.782	−999.000	NaN
49	11	26.753	26.742	36.248	150.2
49	12	26.754	26.781	−999.000	NaN
49	13	26.753	26.781	−999.000	NaN
49	14	26.753	26.780	−999.000	NaN
49	15	26.753	26.780	−999.000	NaN
1	16	26.940	26.940	36.231	200.8
1	17	26.939	26.940	−999.000	NaN
1	18	26.939	26.939	−999.000	NaN


Abaco April 2014 R/V Walton Smith
CTD Station 4 (CTD004)
Latitude 26.999 N Longitude 79.619 W
24−Apr−2014 03:07 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Potential Temperature (deg C)
Oxygen (umol/kg)
Salinity (PSS−78)
Oxygen (umol/kg)

Florida Straits April 2014 R/V Walton Smith
CTD Station 5 (CTD005)
Latitude 27.005N Longitude 79.502W
24-Apr-2014 01:31Z

Pressure dbar	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}	DynHt m^2·s^{-2}	SigT kg·m^{-3}
1	26.979	26.978	36.291	201.0	0.004	23.697
10	26.874	26.872	36.286	201.2	0.042	23.728
20	26.840	26.835	36.287	200.9	0.083	23.740
30	26.822	26.815	36.288	200.8	0.125	23.747
50	26.799	26.787	36.289	200.5	0.208	23.757
75	26.032	26.015	36.438	191.6	0.310	24.114
100	24.331	24.310	36.758	167.1	0.396	24.880
125	22.114	22.089	36.783	156.1	0.464	25.548
150	20.945	20.916	36.728	155.9	0.523	25.834
200	19.051	19.015	36.622	152.4	0.620	26.258
250	17.704	17.661	36.436	158.0	0.707	26.456
300	17.133	17.082	36.404	183.5	0.787	26.573
400	13.587	13.529	35.738	135.1	0.931	26.856
500	11.860	11.794	35.456	126.9	1.055	26.983
600	10.699	10.625	35.282	122.7	1.172	27.063
700	8.693	8.616	35.038	121.6	1.279	27.209

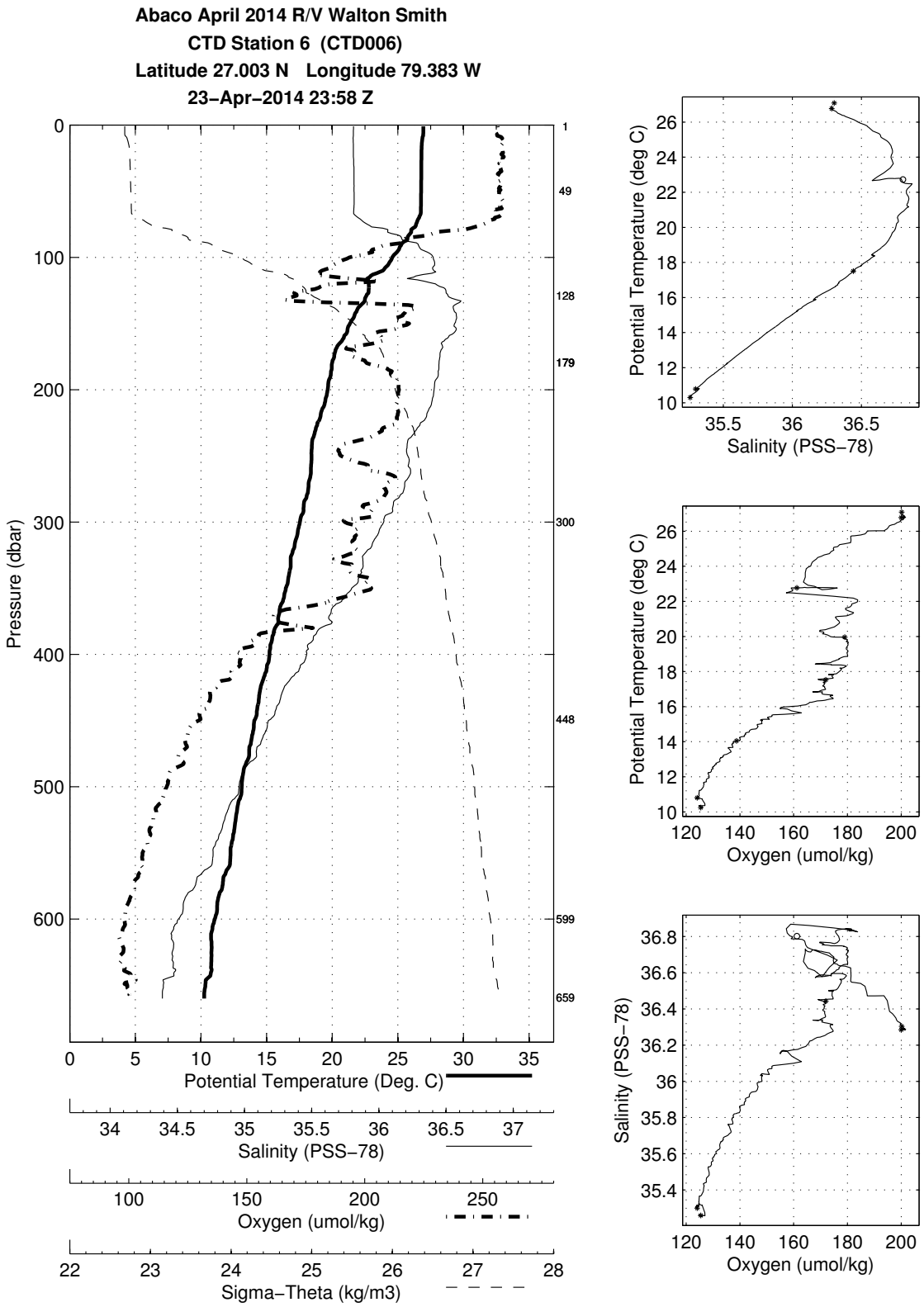
Pressure dbar	Niskin	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}
745	1	7.352	7.278	34.928	129.4
745	2	7.358	8.453	−999.000	NaN
599	3	10.710	10.636	35.283	123.5
599	4	10.710	11.499	−999.000	NaN
450	5	12.432	12.993	−999.000	NaN
451	6	12.433	12.993	−999.000	NaN
299	7	17.096	17.046	36.390	182.5
299	8	17.098	17.403	−999.000	NaN
179	9	19.530	19.693	−999.000	NaN
179	10	19.528	19.691	−999.000	NaN
179	11	19.529	19.691	−999.000	NaN
179	12	19.531	19.694	−999.000	NaN
129	13	21.999	21.973	36.805	157.0
129	14	21.998	22.100	−999.000	NaN
49	15	26.811	26.799	36.294	200.2
49	16	26.811	26.838	−999.000	NaN
2	17	27.029	27.029	36.294	203.9
2	18	27.029	27.030	−999.000	NaN


Abaco April 2014 R/V Walton Smith
CTD Station 5 (CTD005)
Latitude 27.005 N Longitude 79.502 W
24−Apr−2014 01:31 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Potential Temperature (deg C)
Oxygen (umol/kg)
Salinity (PSS−78)
Oxygen (umol/kg)

Florida Straits April 2014 R/V Walton Smith
CTD Station 6 (CTD006)
Latitude 27.003N Longitude 79.383W
23-Apr-2014 23:58Z

Pressure	Temp90	PoTemp90	Salinity	Oxygen	DynHt	SigT
dbar	°C	°C	PSS-78	μmol·kg^{-1}	m^2·s^{-2}	kg·m^{-3}
1	26.938	26.938	36.287	200.3	0.004	23.708
10	26.869	26.867	36.285	201.3	0.042	23.728
20	26.808	26.804	36.286	201.4	0.083	23.749
30	26.797	26.790	36.288	201.2	0.125	23.755
50	26.785	26.774	36.290	200.5	0.208	23.762
75	26.408	26.391	36.362	197.4	0.311	23.938
100	24.591	24.570	36.718	170.3	0.400	24.771
125	22.799	22.774	36.786	161.5	0.473	25.355
150	21.378	21.348	36.833	182.4	0.534	25.794
200	19.689	19.652	36.722	180.3	0.636	26.168
250	18.462	18.418	36.580	168.5	0.726	26.378
300	17.588	17.537	36.450	169.3	0.811	26.497
400	15.282	15.220	36.034	148.3	0.964	26.721
500	13.175	13.105	35.669	133.3	1.101	26.890
600	11.122	11.046	35.341	124.8	1.225	27.033

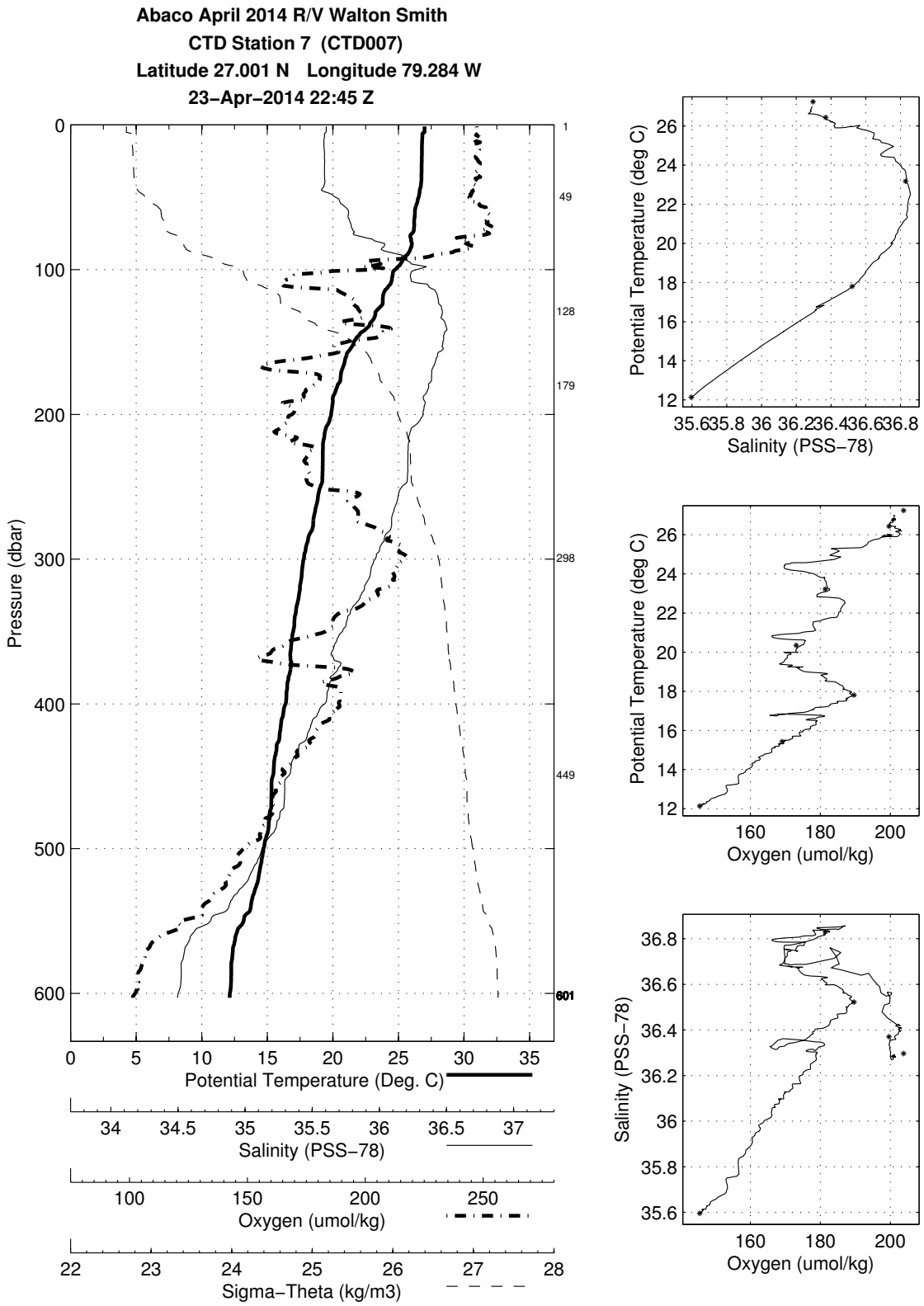
Pressure	Niskin	Temp90	PoTemp90	Salinity	Oxygen
dbar		°C	°C	PSS-78	μmol·kg^{-1}
659	1	10.374	10.294	35.260	125.4
659	2	10.395	11.271	−999.000	NaN
600	3	10.865	10.790	35.300	124.1
600	4	10.847	11.633	−999.000	NaN
449	5	14.101	14.623	−999.000	NaN
449	6	14.102	14.624	−999.000	NaN
300	7	17.559	17.859	−999.000	NaN
300	8	17.559	17.508	36.442	171.9
179	9	19.998	20.157	−999.000	NaN
179	10	19.998	20.157	−999.000	NaN
179	11	19.999	20.158	−999.000	NaN
179	12	19.999	20.158	−999.000	NaN
129	13	22.756	22.730	36.801	161.2
129	14	22.761	22.858	−999.000	NaN
50	15	26.778	26.767	36.285	200.0
50	16	26.778	26.806	−999.000	NaN
1	17	27.087	27.087	36.303	200.2
1	18	27.090	27.090	−999.000	NaN


Abaco April 2014 R/V Walton Smith
CTD Station 6 (CTD006)
Latitude 27.003 N Longitude 79.383 W
23−Apr−2014 23:58 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Potential Temperature (deg C)
Oxygen (umol/kg)
Salinity (PSS−78)
Oxygen (umol/kg)

Florida Straits April 2014 R/V Walton Smith
CTD Station 7 (CTD007)
Latitude 27.001N Longitude 79.284W
23-Apr-2014 22:45Z

Pressure dbar	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}	DynHt m^2·s^{-2}	SigT kg·m^{-3}
1	26.992	26.992	36.293	200.8	0.004	23.694
10	26.815	26.813	36.282	200.5	0.042	23.744
20	26.794	26.789	36.284	200.8	0.083	23.753
30	26.776	26.769	36.284	201.1	0.125	23.759
50	26.551	26.540	36.336	199.6	0.207	23.871
75	26.052	26.035	36.418	202.9	0.305	24.092
100	24.764	24.742	36.714	184.0	0.395	24.716
125	23.714	23.688	36.829	181.3	0.472	25.120
150	21.625	21.596	36.837	179.9	0.537	25.728
200	19.911	19.874	36.744	171.2	0.642	26.127
250	19.096	19.051	36.647	174.8	0.735	26.267
300	17.834	17.783	36.521	189.2	0.822	26.492
400	16.462	16.397	36.285	178.7	0.981	26.644
500	14.788	14.712	35.991	163.5	1.127	26.800
600	12.233	12.152	35.600	146.1	1.255	27.026

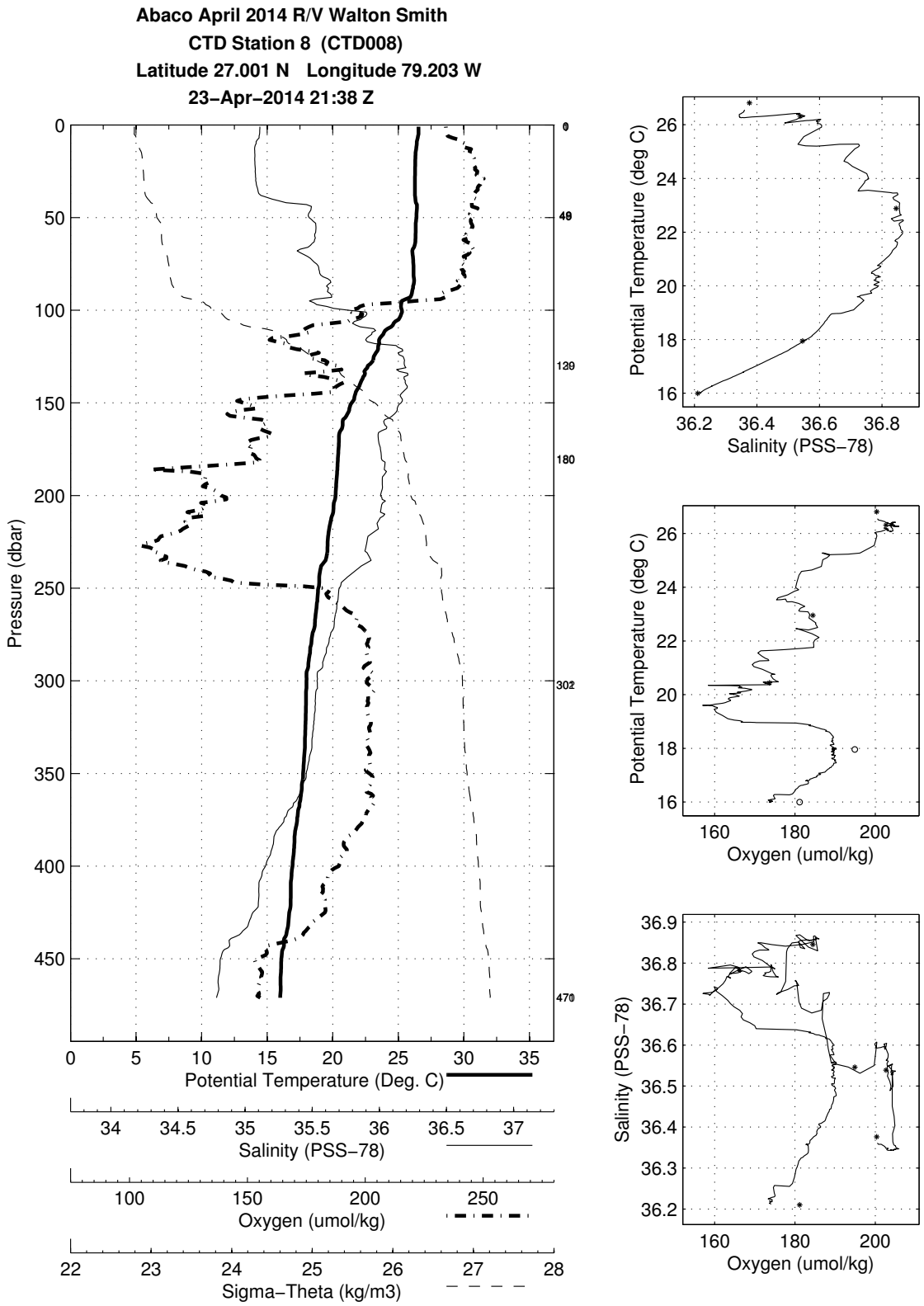
Pressure dbar	Niskin	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}
602	1	12.227	12.975	−999.000	NaN
601	2	12.227	12.975	−999.000	NaN
601	3	12.230	12.977	−999.000	NaN
601	4	12.233	12.980	−999.000	NaN
601	5	12.233	12.981	−999.000	NaN
601	6	12.236	12.983	−999.000	NaN
601	7	12.239	12.986	−999.000	NaN
601	8	12.240	12.987	−999.000	NaN
601	9	12.241	12.988	−999.000	NaN
601	10	12.240	12.987	−999.000	NaN
601	11	12.233	12.980	−999.000	NaN
601	12	12.224	12.971	−999.000	NaN
601	13	12.223	12.970	−999.000	NaN
601	14	12.223	12.970	−999.000	NaN
602	15	12.223	12.971	−999.000	NaN
602	16	12.223	12.971	−999.000	NaN
602	17	12.223	12.971	−999.000	NaN
602	18	12.222	12.141	35.596	145.5
449	19	15.451	15.943	−999.000	NaN
299	20	17.848	17.797	36.522	189.6
180	21	20.356	20.512	−999.000	NaN
129	22	23.203	23.176	36.829	181.4
49	23	26.450	26.439	36.370	199.6
1	24	27.239	27.238	36.297	203.8


Abaco April 2014 R/V Walton Smith
CTD Station 7 (CTD007)
Latitude 27.001 N Longitude 79.284 W
23−Apr−2014 22:45 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Potential Temperature (deg C)
Oxygen (umol/kg)
Salinity (PSS−78)
Oxygen (umol/kg)

Florida Straits April 2014 R/V Walton Smith
CTD Station 8 (CTD008)
Latitude 27.001N Longitude 79.203W
23-Apr-2014 21:38Z

Pressure	Temp90	PoTemp90	Salinity	Oxygen	DynHt	SigT
dbar	°C	°C	PSS-78	μmol·kg^{-1}	m^2·s^{-2}	kg·m^{-3}
1	26.541	26.540	36.361	200.5	0.004	23.890
10	26.410	26.408	36.348	203.2	0.040	23.922
20	26.298	26.293	36.344	204.6	0.080	23.956
30	26.272	26.266	36.347	205.4	0.119	23.966
50	26.393	26.382	36.530	204.5	0.197	24.068
75	26.167	26.150	36.555	202.9	0.293	24.160
100	25.295	25.273	36.664	186.8	0.385	24.516
125	23.150	23.125	36.852	180.9	0.461	25.303
150	21.469	21.440	36.845	171.7	0.523	25.778
200	20.247	20.209	36.774	168.5	0.627	26.060
250	18.936	18.891	36.633	183.0	0.722	26.298
300	18.047	17.995	36.557	189.3	0.809	26.466
400	16.992	16.926	36.380	185.3	0.973	26.592

Pressure	Niskin	Temp90	PoTemp90	Salinity	Oxygen
dbar		°C	°C	PSS-78	μmol·kg^{-1}
471	1	16.071	15.995	36.210	181.2
471	2	16.069	16.570	−999.000	NaN
302	3	17.997	17.945	36.546	194.9
302	4	17.997	18.292	−999.000	NaN
180	5	20.463	20.618	−999.000	NaN
181	6	20.462	20.618	−999.000	NaN
130	7	22.910	22.883	36.845	184.4
130	8	22.892	22.989	−999.000	NaN
49	9	26.325	26.314	36.539	202.7
49	10	26.330	26.359	−999.000	NaN
49	11	26.326	26.354	−999.000	NaN
1	12	26.808	26.809	−999.000	NaN
1	13	26.811	26.811	36.376	200.3
1	14	26.814	26.815	−999.000	NaN

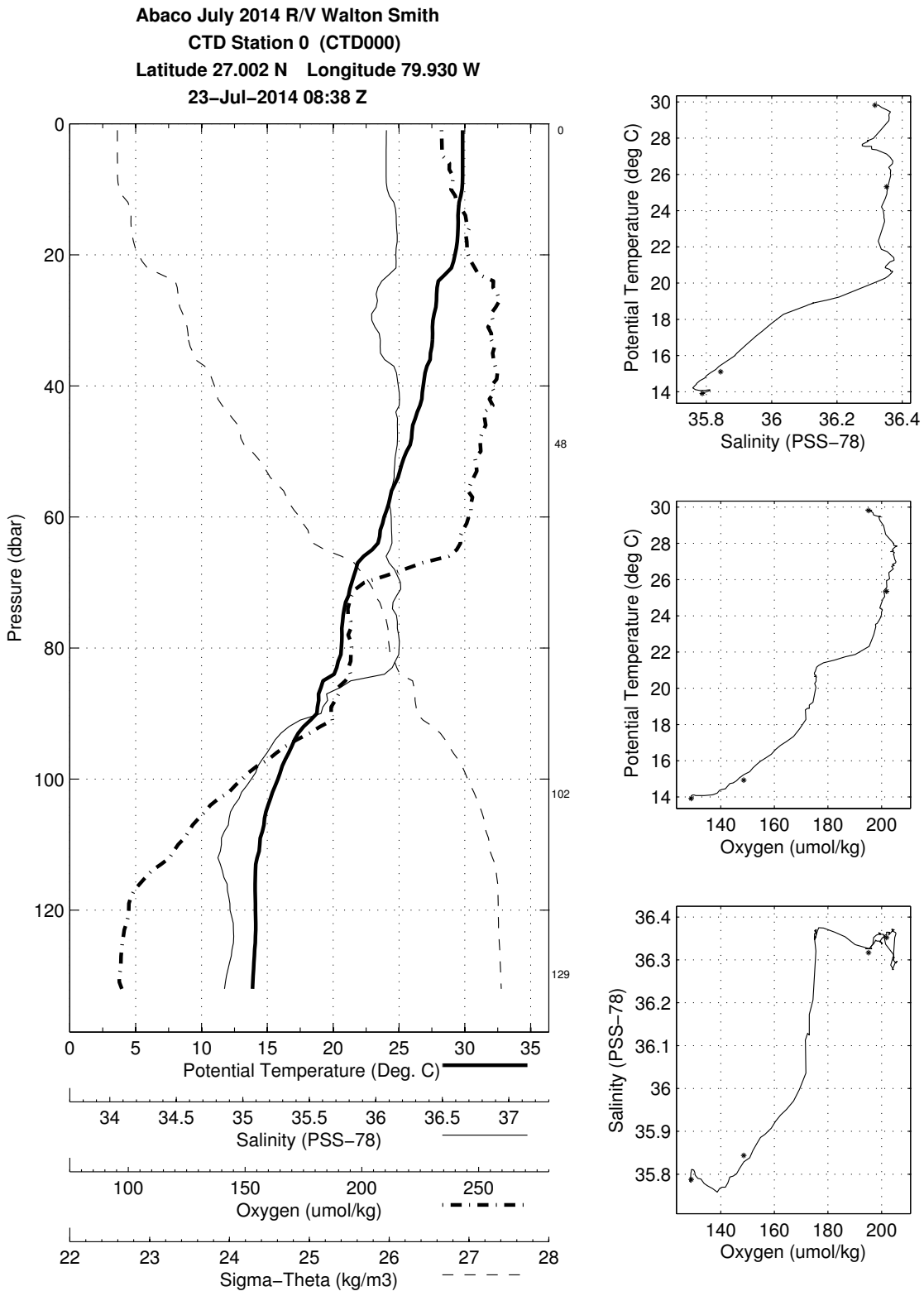

Abaco April 2014 R/V Walton Smith
CTD Station 8 (CTD008)
Latitude 27.001 N Longitude 79.203 W
23−Apr−2014 21:38 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Potential Temperature (deg C)
Oxygen (umol/kg)
Salinity (PSS−78)
Oxygen (umol/kg)

A.2 WS1409

Florida Straits July 2014 R/V Walton Smith
CTD Station 0 (CTD000)
Latitude 27.002N Longitude 79.930W
23-Jul-2014 08:38Z

Pressure dbar	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}	DynHt m^2·s^{-2}	SigT kg·m^{-3}
1	29.836	29.836	36.327	194.0	0.005	22.778
10	29.786	29.784	36.330	195.9	0.051	22.797
20	29.256	29.251	36.359	199.4	0.100	23.000
30	27.586	27.579	36.277	204.4	0.145	23.493
50	25.590	25.579	36.360	202.0	0.227	24.191
75	20.773	20.759	36.361	175.0	0.304	25.596
100	15.816	15.800	35.871	153.4	0.355	26.464
125	14.098	14.080	35.811	129.1	0.389	26.797

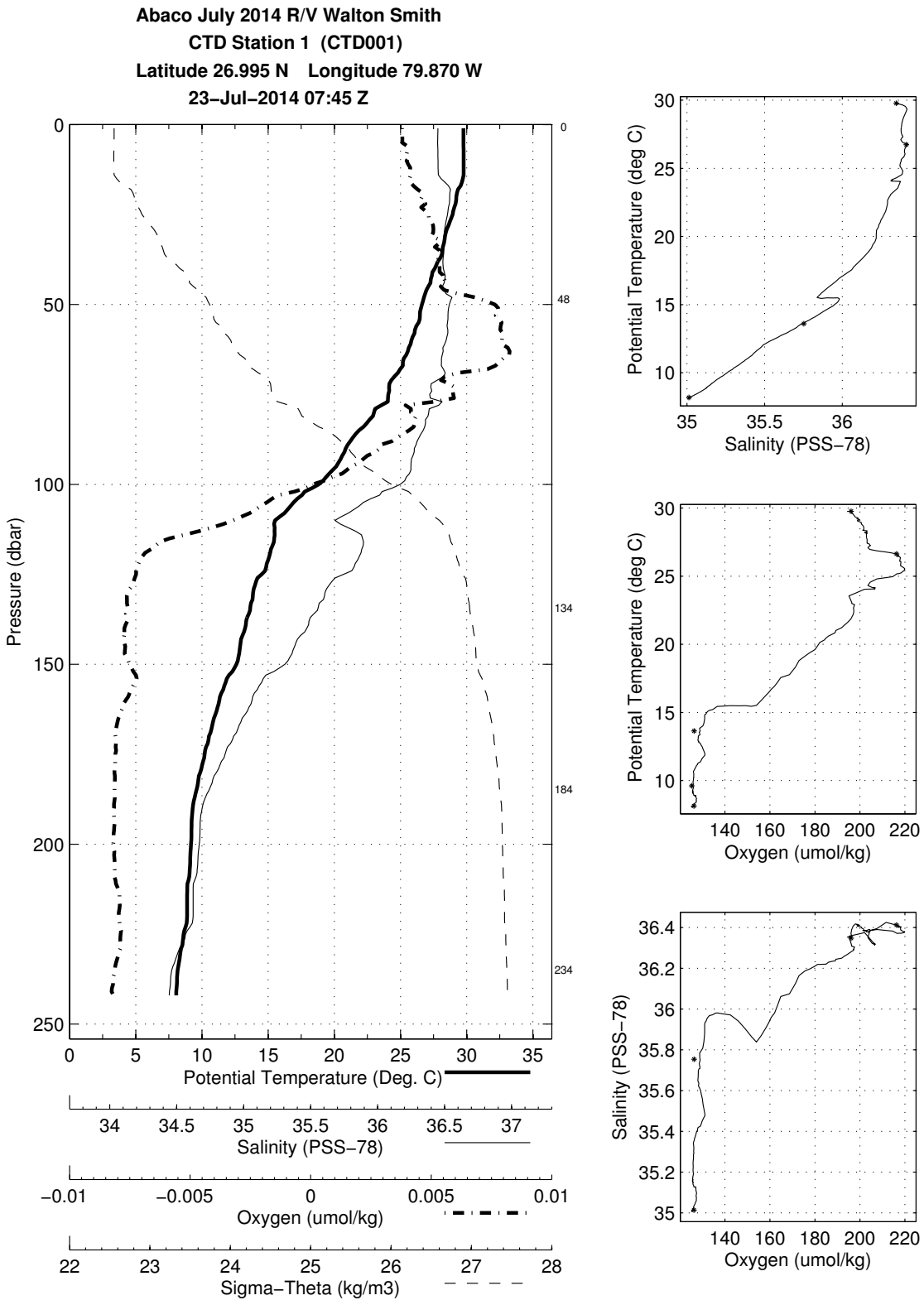
Pressure dbar	Niskin	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}
130	1	13.929	13.911	35.788	129.0
102	2	15.127	15.112	35.844	148.6
49	3	25.326	25.316	36.352	201.9
1	4	29.821	29.821	36.317	195.1


Abaco July 2014 R/V Walton Smith
CTD Station 0 (CTD000)
Latitude 27.002 N Longitude 79.930 W
23−Jul−2014 08:38 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Potential Temperature (deg C)
Oxygen (umol/kg)
Salinity (PSS−78)
Oxygen (umol/kg)

Florida Straits July 2014 R/V Walton Smith
CTD Station 1 (CTD001)
Latitude 26.995N Longitude 79.870W
23-Jul-2014 07:45Z

Pressure	Temp90	PoTemp90	Salinity	Oxygen	DynHt	SigT
dbar	°C	°C	PSS-78	μmol·kg^{-1}	m^2·s^{-2}	kg·m^{-3}
1	29.757	29.757	36.354	194.3	0.005	22.825
10	29.772	29.769	36.355	195.4	0.050	22.821
20	29.225	29.220	36.413	199.0	0.100	23.051
30	28.432	28.425	36.386	201.7	0.147	23.297
50	26.631	26.619	36.412	216.4	0.233	23.903
75	24.100	24.084	36.313	206.4	0.325	24.611
100	18.824	18.806	36.164	172.9	0.392	25.961
125	14.530	14.511	35.881	131.0	0.431	26.759
150	12.626	12.606	35.587	129.4	0.461	26.927
200	9.196	9.174	35.157	125.5	0.510	27.213

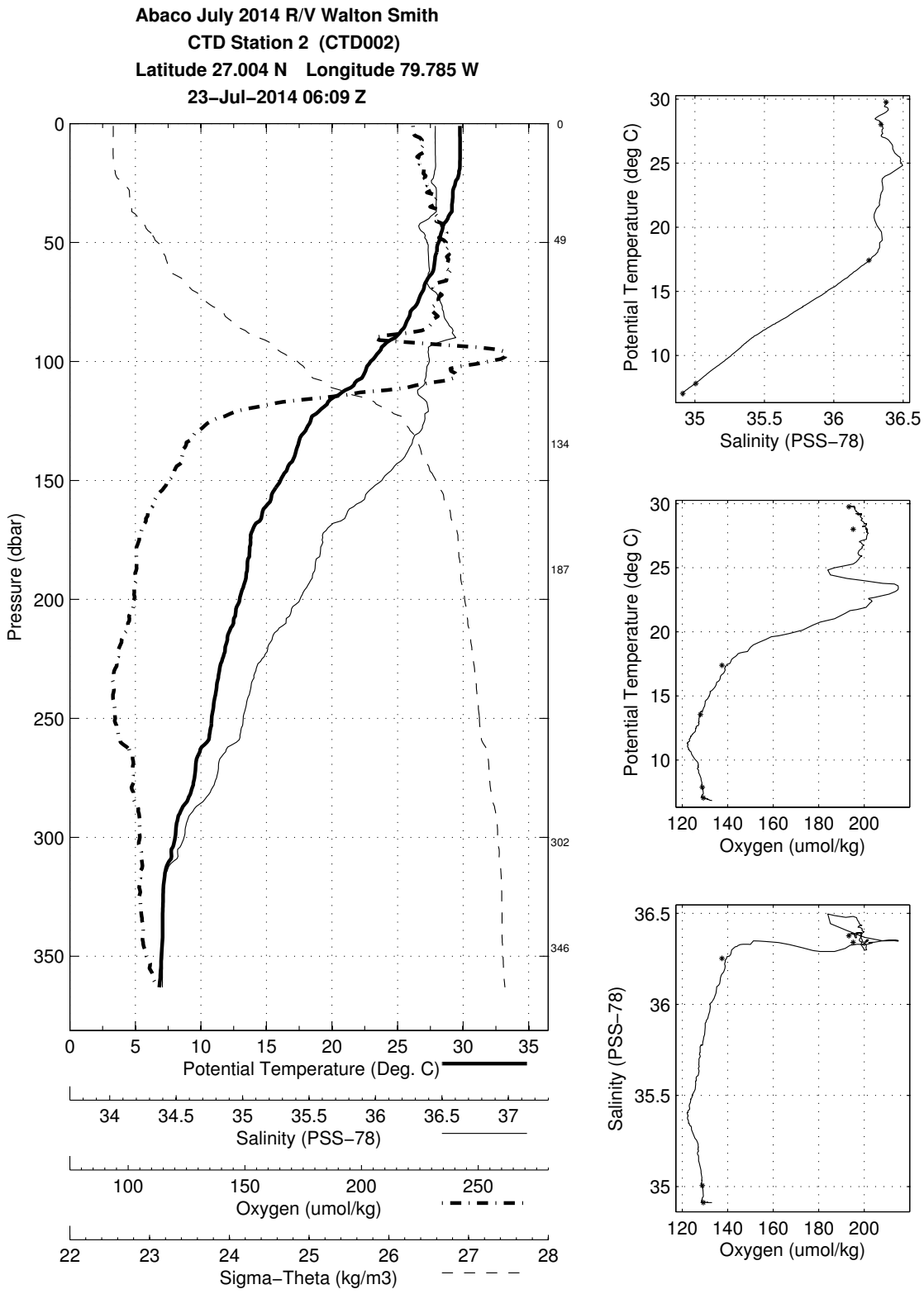
Pressure	Niskin	Temp90	PoTemp90	Salinity	Oxygen
dbar		°C	°C	PSS-78	μmol·kg^{-1}
235	1	8.206	8.182	35.013	126.2
185	2	9.625	9.885	−999.000	NaN
134	3	13.609	13.590	35.753	126.3
49	4	26.753	26.742	36.412	216.3
1	5	29.775	29.775	36.348	196.1


Abaco July 2014 R/V Walton Smith
CTD Station 1 (CTD001)
Latitude 26.995 N Longitude 79.870 W
23–Jul–2014 07:45 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS–78)
Oxygen (umol/kg)
Sigma–Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS–78)
Potential Temperature (deg C)
Oxygen (umol/kg)
Salinity (PSS–78)
Oxygen (umol/kg)

Florida Straits July 2014 R/V Walton Smith
CTD Station 2 (CTD002)
Latitude 27.004N Longitude 79.785W
23-Jul-2014 06:09Z

Pressure dbar	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}	DynHt m^2·s^{-2}	SigT kg·m^{-3}
1	29.761	29.761	36.387	193.1	0.005	22.848
10	29.767	29.765	36.387	195.1	0.050	22.847
20	29.691	29.686	36.382	195.6	0.100	22.870
30	29.228	29.220	36.393	198.4	0.149	23.036
50	28.142	28.130	36.341	200.9	0.243	23.361
75	26.575	26.558	36.414	199.2	0.351	23.924
100	22.965	22.944	36.354	210.8	0.439	24.977
125	18.386	18.364	36.328	145.5	0.500	26.199
150	16.092	16.068	36.097	135.2	0.542	26.576
200	12.985	12.957	35.655	127.3	0.607	26.909
250	10.854	10.823	35.348	122.9	0.662	27.079
300	8.066	8.035	35.029	128.7	0.708	27.291

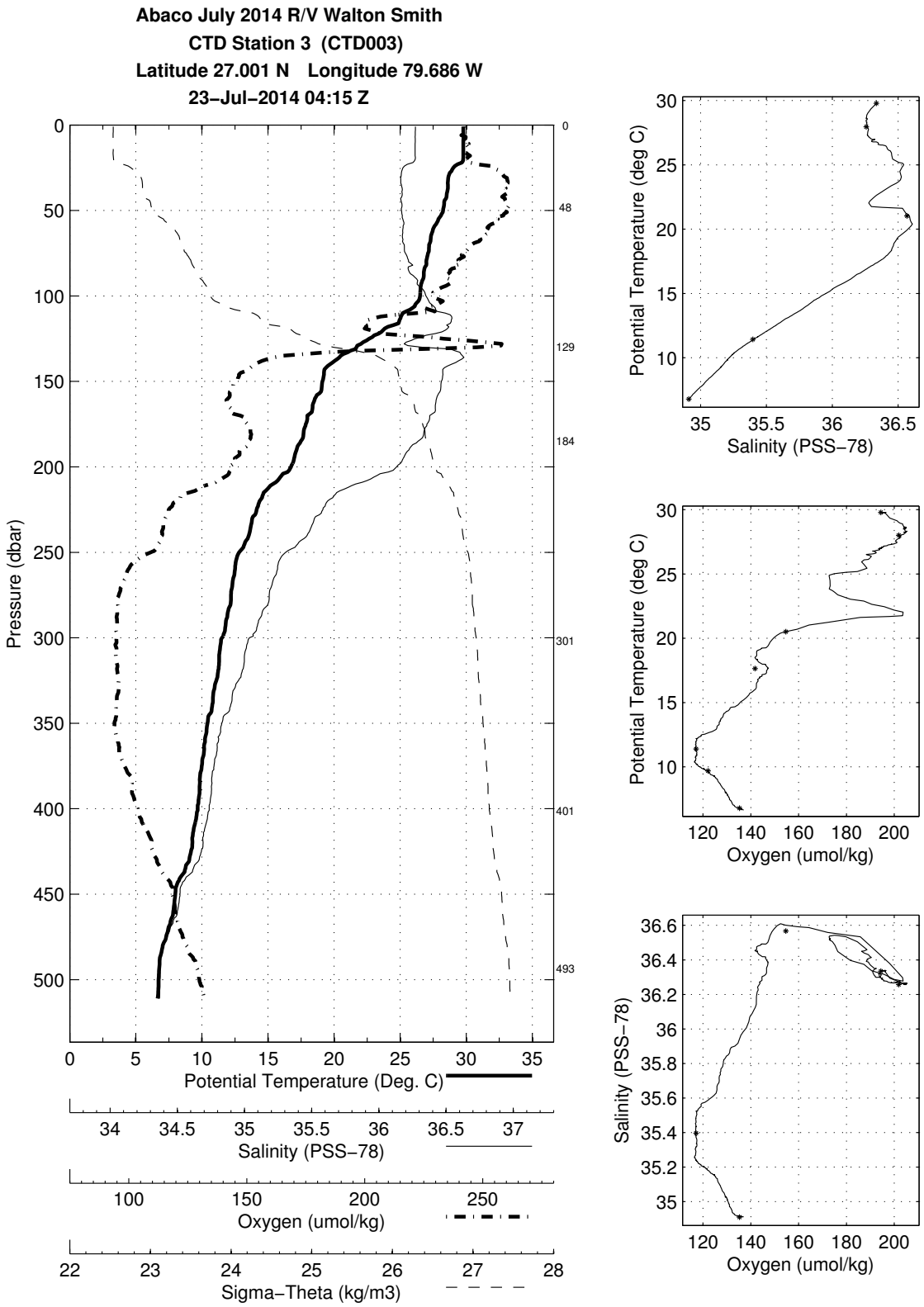
Pressure dbar	Niskin	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}
346	1	7.063	7.030	34.912	129.3
302	2	7.841	7.810	35.006	128.8
187	3	13.554	13.780	−999.000	NaN
135	4	17.441	17.418	36.253	137.5
49	5	28.024	28.013	36.340	195.1
0	6	29.766	29.766	36.377	193.2


Abaco July 2014 R/V Walton Smith
CTD Station 2 (CTD002)
Latitude 27.004 N Longitude 79.785 W
23−Jul−2014 06:09 Z
Pressure (dbar)
0
50
100
150
200
250
300
350
0
49
134
187
302
346
0 5 10 15 20 25 30 35
Potential Temperature (Deg. C)
34 34.5 35 35.5 36 36.5 37
Salinity (PSS−78)
100 150 200 250
Oxygen (umol/kg)
22 23 24 25 26 27 28
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
35 35.5 36 36.5
Salinity (PSS−78)
Potential Temperature (deg C)
120 140 160 180 200
Oxygen (umol/kg)
Salinity (PSS−78)
120 140 160 180 200
Oxygen (umol/kg)

Florida Straits July 2014 R/V Walton Smith
CTD Station 3 (CTD003)
Latitude 27.001N Longitude 79.686W
23-Jul-2014 04:15Z

Pressure	Temp90	PoTemp90	Salinity	Oxygen	DynHt	SigT
dbar	°C	°C	PSS-78	μmol·kg^{-1}	m^2·s^{-2}	kg·m^{-3}
1	29.784	29.784	36.339	195.2	0.005	22.805
10	29.786	29.784	36.338	195.4	0.050	22.804
20	29.775	29.770	36.338	196.5	0.101	22.809
30	28.672	28.664	36.259	204.1	0.150	23.122
50	28.258	28.246	36.262	204.0	0.244	23.263
75	27.127	27.110	36.284	195.6	0.354	23.650
100	26.525	26.502	36.398	188.6	0.457	23.930
125	22.669	22.644	36.337	190.6	0.544	25.051
150	19.144	19.116	36.483	143.8	0.600	26.125
200	16.772	16.739	36.234	143.0	0.686	26.524
250	12.847	12.813	35.615	124.6	0.753	26.907
300	11.555	11.516	35.414	116.9	0.812	27.002
400	9.727	9.681	35.189	121.7	0.917	27.154
500	6.763	6.716	34.915	135.6	1.004	27.391

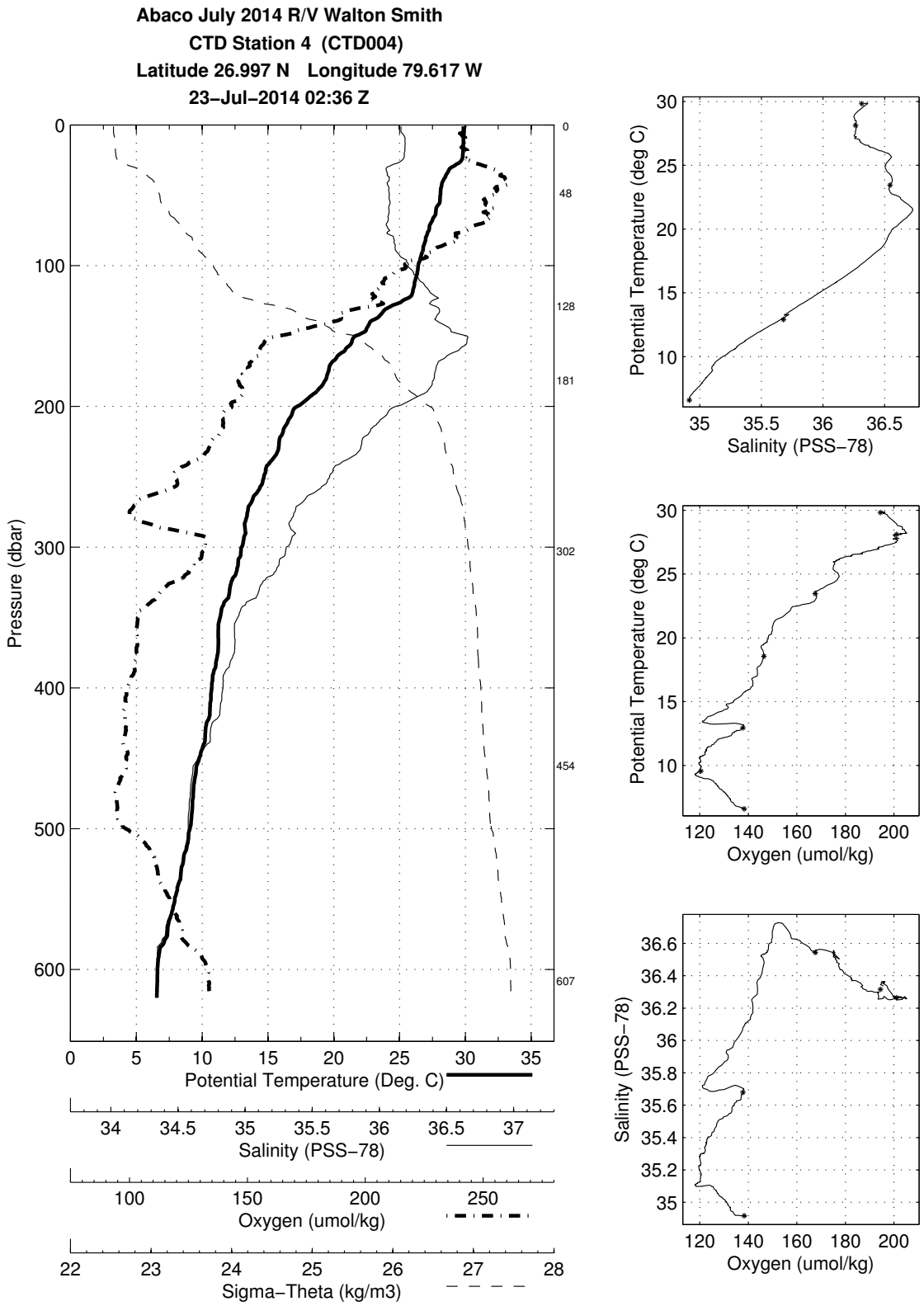
Pressure	Niskin	Temp90	PoTemp90	Salinity	Oxygen
dbar		°C	°C	PSS-78	μmol·kg^{-1}
493	1	6.831	6.785	34.910	135.2
401	2	9.733	10.288	−999.000	NaN
302	3	11.463	11.424	35.397	117.1
185	4	17.556	17.742	−999.000	NaN
130	5	21.058	21.033	36.567	154.6
48	6	27.968	27.956	36.258	201.9
0	7	29.782	29.782	36.335	194.4


Abaco July 2014 R/V Walton Smith
CTD Station 3 (CTD003)
Latitude 27.001 N Longitude 79.686 W
23−Jul−2014 04:15 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Potential Temperature (deg C)
Oxygen (umol/kg)
Salinity (PSS−78)
Oxygen (umol/kg)

Florida Straits July 2014 R/V Walton Smith
CTD Station 4 (CTD004)
Latitude 26.997N Longitude 79.617W
23-Jul-2014 02:36Z

Pressure	Temp90	PoTemp90	Salinity	Oxygen	DynHt	SigT
dbar	°C	°C	PSS-78	μmol·kg^{-1}	m^2·s^{-2}	kg·m^{-3}
1	29.848	29.848	36.339	195.5	0.005	22.782
10	29.857	29.855	36.361	195.5	0.051	22.797
20	29.818	29.813	36.357	196.1	0.101	22.808
30	28.975	28.968	36.257	200.9	0.151	23.019
50	28.099	28.088	36.269	201.5	0.244	23.321
75	27.245	27.228	36.272	195.9	0.356	23.603
100	26.442	26.419	36.379	182.3	0.459	23.942
125	25.236	25.208	36.518	175.8	0.555	24.425
150	21.656	21.627	36.724	154.1	0.629	25.633
200	17.254	17.220	36.307	143.8	0.730	26.465
250	14.733	14.695	35.922	131.0	0.804	26.750
300	13.034	12.993	35.669	138.0	0.868	26.913
400	10.777	10.727	35.301	120.5	0.983	27.059
500	9.128	9.072	35.099	120.2	1.087	27.184
600	6.660	6.603	34.915	138.4	1.174	27.406

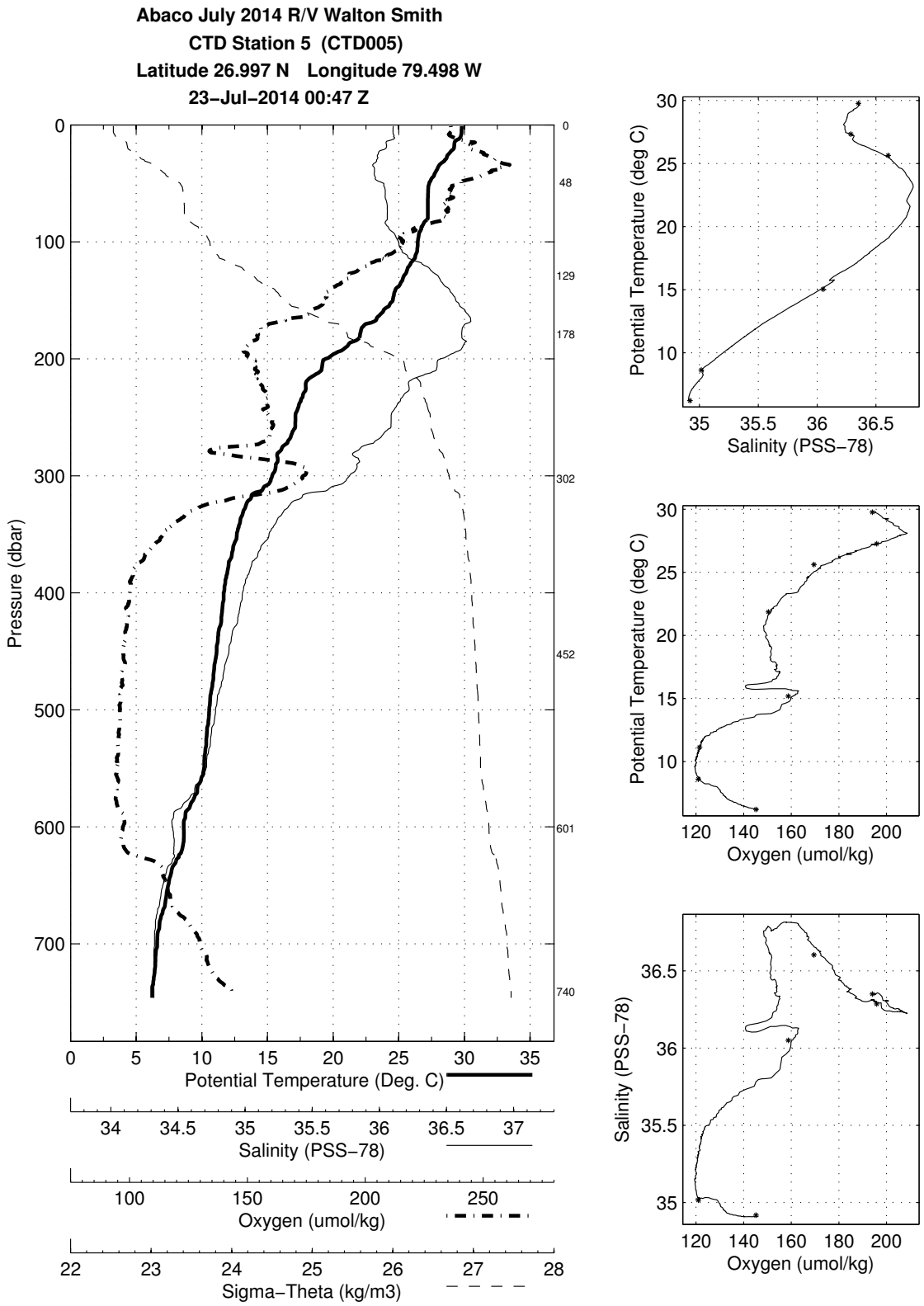
Pressure	Niskin	Temp90	PoTemp90	Salinity	Oxygen
dbar		°C	°C	PSS-78	μmol·kg^{-1}
608	1	6.647	6.590	34.916	138.3
455	2	9.661	10.289	−999.000	NaN
303	3	12.951	12.909	35.680	137.8
181	4	18.532	18.706	−999.000	NaN
129	5	23.470	23.443	36.545	167.5
49	6	28.127	28.115	36.264	201.1
1	7	29.827	29.827	36.315	194.4


Abaco July 2014 R/V Walton Smith
CTD Station 4 (CTD004)
Latitude 26.997 N Longitude 79.617 W
23−Jul−2014 02:36 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Potential Temperature (deg C)
Oxygen (umol/kg)
Salinity (PSS−78)
Oxygen (umol/kg)

Florida Straits July 2014 R/V Walton Smith
CTD Station 5 (CTD005)
Latitude 26.997N Longitude 79.498W
23-Jul-2014 00:47Z

Pressure	Temp90	PoTemp90	Salinity	Oxygen	DynHt	SigT
dbar	°C	°C	PSS-78	μmol·kg^{-1}	m^2·s^{-2}	kg·m^{-3}
1	29.787	29.787	36.349	195.3	0.005	22.811
10	29.715	29.712	36.351	195.5	0.050	22.838
20	29.202	29.198	36.306	199.5	0.099	22.978
30	28.507	28.499	36.249	205.2	0.147	23.169
50	27.326	27.314	36.293	197.7	0.237	23.590
75	27.233	27.216	36.314	193.7	0.345	23.638
100	26.469	26.446	36.382	184.3	0.448	23.936
125	25.628	25.601	36.581	174.1	0.545	24.352
150	24.577	24.545	36.725	166.8	0.629	24.785
200	19.467	19.430	36.633	150.6	0.758	26.158
250	17.169	17.127	36.337	154.9	0.844	26.510
300	15.402	15.355	36.086	161.9	0.920	26.731
400	11.723	11.671	35.442	122.8	1.043	26.995
500	10.619	10.558	35.281	120.5	1.156	27.074
600	8.684	8.619	35.022	121.2	1.263	27.196
700	6.663	6.597	34.913	138.6	1.350	27.406

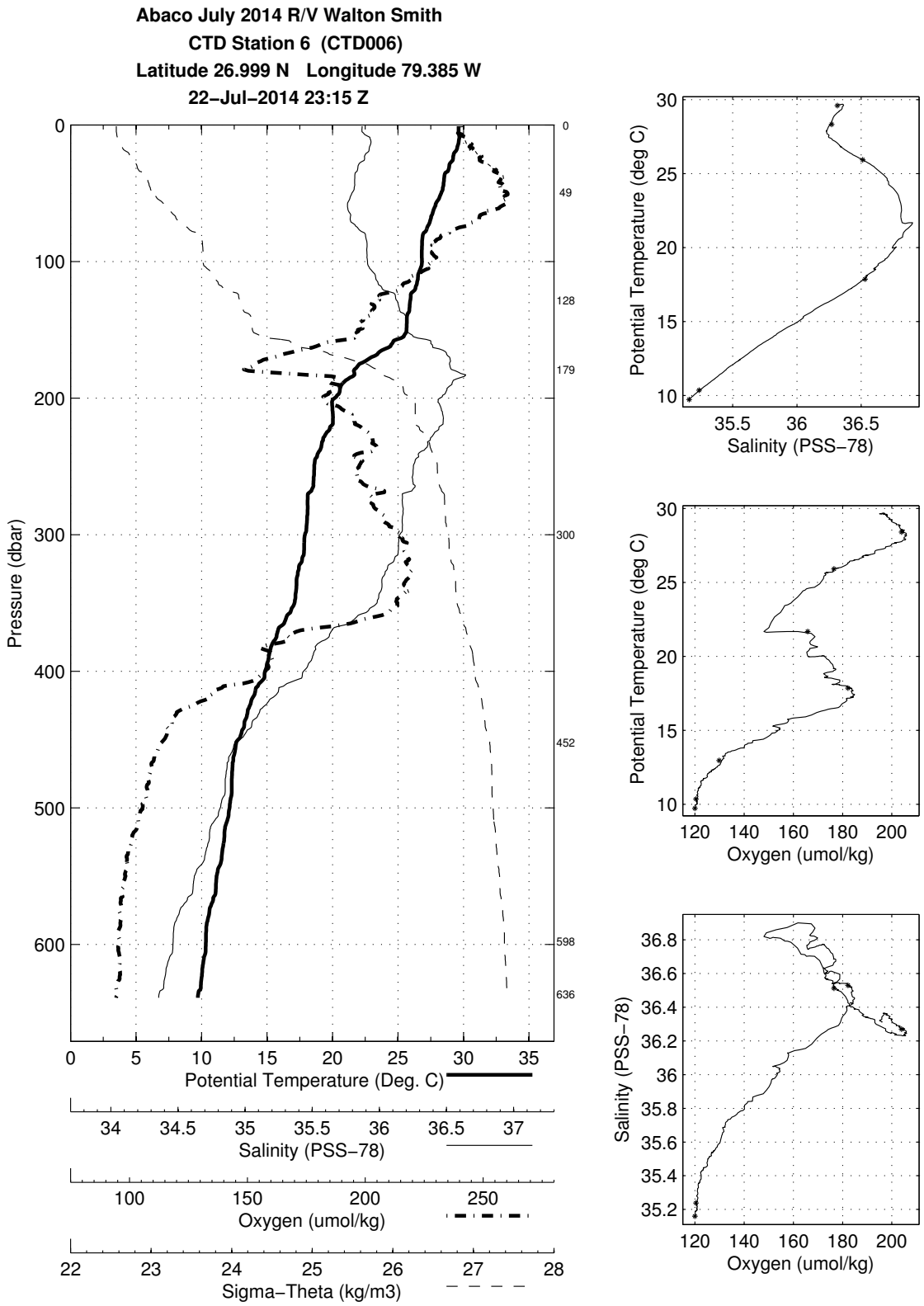
Pressure	Niskin	Temp90	PoTemp90	Salinity	Oxygen
dbar		°C	°C	PSS-78	μmol·kg^{-1}
741	1	6.285	6.217	34.919	145.1
601	2	8.705	8.639	35.016	120.9
452	3	11.199	11.790	−999.000	NaN
302	4	15.080	15.033	36.050	158.7
179	5	21.710	21.853	−999.000	NaN
129	6	25.673	25.644	36.604	169.5
49	7	27.339	27.328	36.286	195.9
0	8	29.765	29.765	36.350	194.0


Abaco July 2014 R/V Walton Smith
CTD Station 5 (CTD005)
Latitude 26.997 N Longitude 79.498 W
23−Jul−2014 00:47 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Potential Temperature (deg C)
Oxygen (umol/kg)
Salinity (PSS−78)
Oxygen (umol/kg)

Florida Straits July 2014 R/V Walton Smith
CTD Station 6 (CTD006)
Latitude 26.999N Longitude 79.385W
22-Jul-2014 23:15Z

Pressure	Temp90	PoTemp90	Salinity	Oxygen	DynHt	SigT
dbar	°C	°C	PSS-78	μmol·kg^{-1}	m^2·s^{-2}	kg·m^{-3}
1	29.627	29.627	36.314	195.9	0.005	22.839
10	29.675	29.672	36.358	196.9	0.050	22.857
20	29.334	29.329	36.346	199.3	0.100	22.964
30	28.914	28.907	36.291	201.7	0.148	23.065
50	28.302	28.290	36.256	205.9	0.242	23.244
75	27.242	27.224	36.287	195.3	0.354	23.616
100	26.842	26.819	36.344	189.2	0.459	23.788
125	25.997	25.969	36.502	177.7	0.559	24.177
150	25.681	25.648	36.570	173.0	0.652	24.328
200	20.198	20.161	36.754	165.6	0.784	26.058
250	18.648	18.604	36.604	173.4	0.879	26.349
300	17.942	17.890	36.528	182.9	0.965	26.470
400	14.904	14.843	35.981	152.7	1.120	26.763
500	12.202	12.135	35.509	125.8	1.248	26.959
600	10.395	10.322	35.241	120.7	1.365	27.085

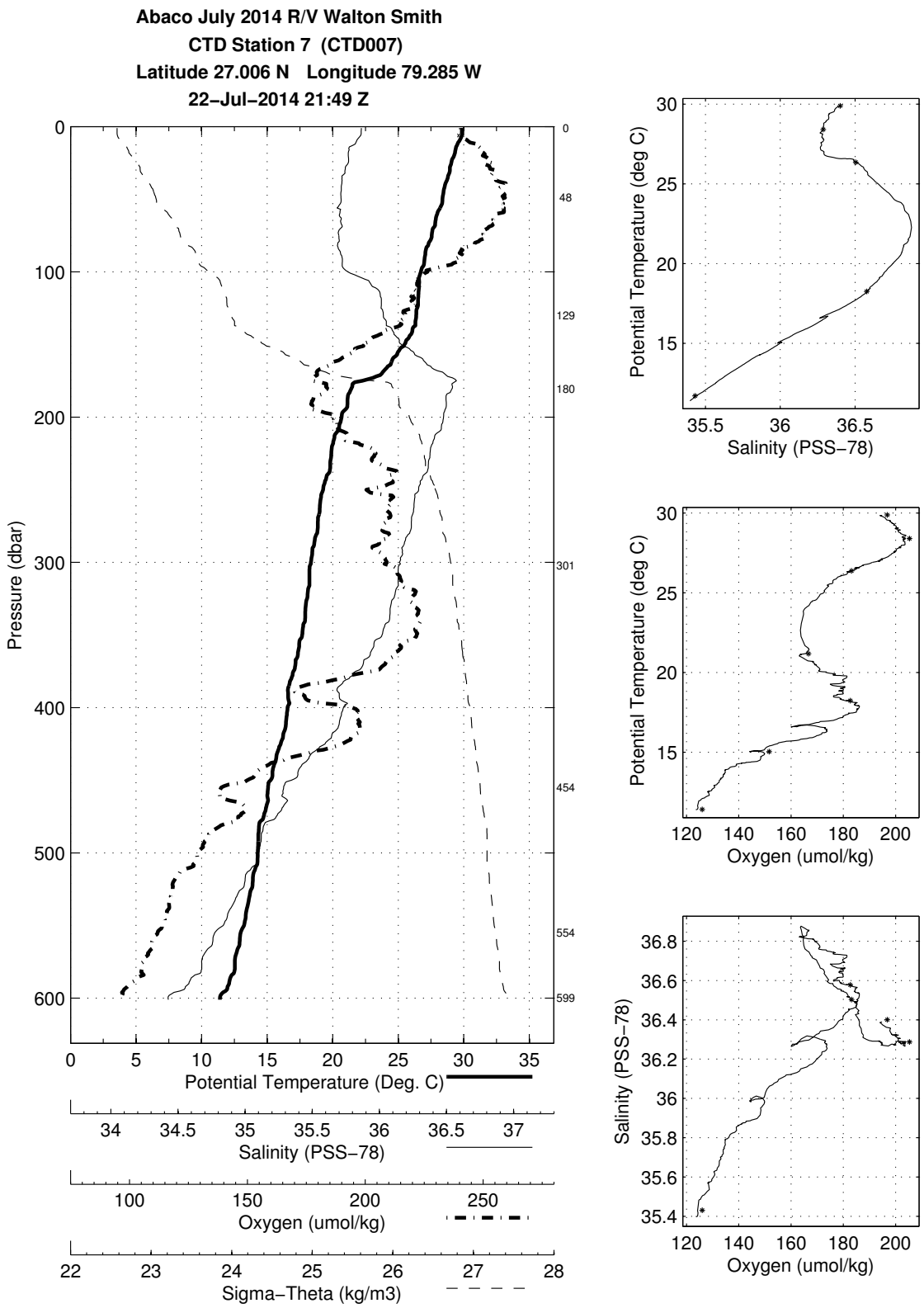
Pressure	Niskin	Temp90	PoTemp90	Salinity	Oxygen
dbar		°C	°C	PSS-78	μmol·kg^{-1}
636	1	9.796	9.721	35.160	120.0
598	2	10.429	10.356	35.238	120.4
452	3	12.962	13.513	−999.000	NaN
300	4	17.915	17.863	36.531	182.2
179	5	21.743	21.886	−999.000	NaN
129	6	25.962	25.933	36.512	176.5
49	7	28.334	28.322	36.270	204.0
0	8	29.593	29.592	36.316	NaN


Abaco July 2014 R/V Walton Smith
CTD Station 6 (CTD006)
Latitude 26.999 N Longitude 79.385 W
22−Jul−2014 23:15 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Potential Temperature (deg C)
Oxygen (umol/kg)
Salinity (PSS−78)
Oxygen (umol/kg)

Florida Straits July 2014 R/V Walton Smith
CTD Station 7 (CTD007)
Latitude 27.006N Longitude 79.285W
22-Jul-2014 21:49Z

Pressure dbar	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}	DynHt m^2·s^{-2}	SigT kg·m^{-3}
1	29.856	29.856	36.389	194.6	0.005	22.818
10	29.657	29.655	36.364	196.2	0.050	22.867
20	29.264	29.259	36.322	199.2	0.100	22.970
30	28.945	28.938	36.305	201.8	0.148	23.066
50	28.384	28.372	36.286	202.8	0.242	23.239
75	27.573	27.555	36.273	199.8	0.355	23.498
100	26.741	26.718	36.321	187.7	0.462	23.803
125	26.471	26.442	36.491	184.6	0.562	24.019
150	25.514	25.481	36.595	173.8	0.657	24.399
200	20.722	20.684	36.811	168.6	0.791	25.960
250	19.309	19.263	36.683	175.0	0.890	26.240
300	18.383	18.330	36.584	179.3	0.980	26.403
400	16.624	16.558	36.297	172.1	1.145	26.616
500	14.352	14.277	35.863	140.0	1.292	26.795
600	11.476	11.398	35.398	123.9	1.424	27.012

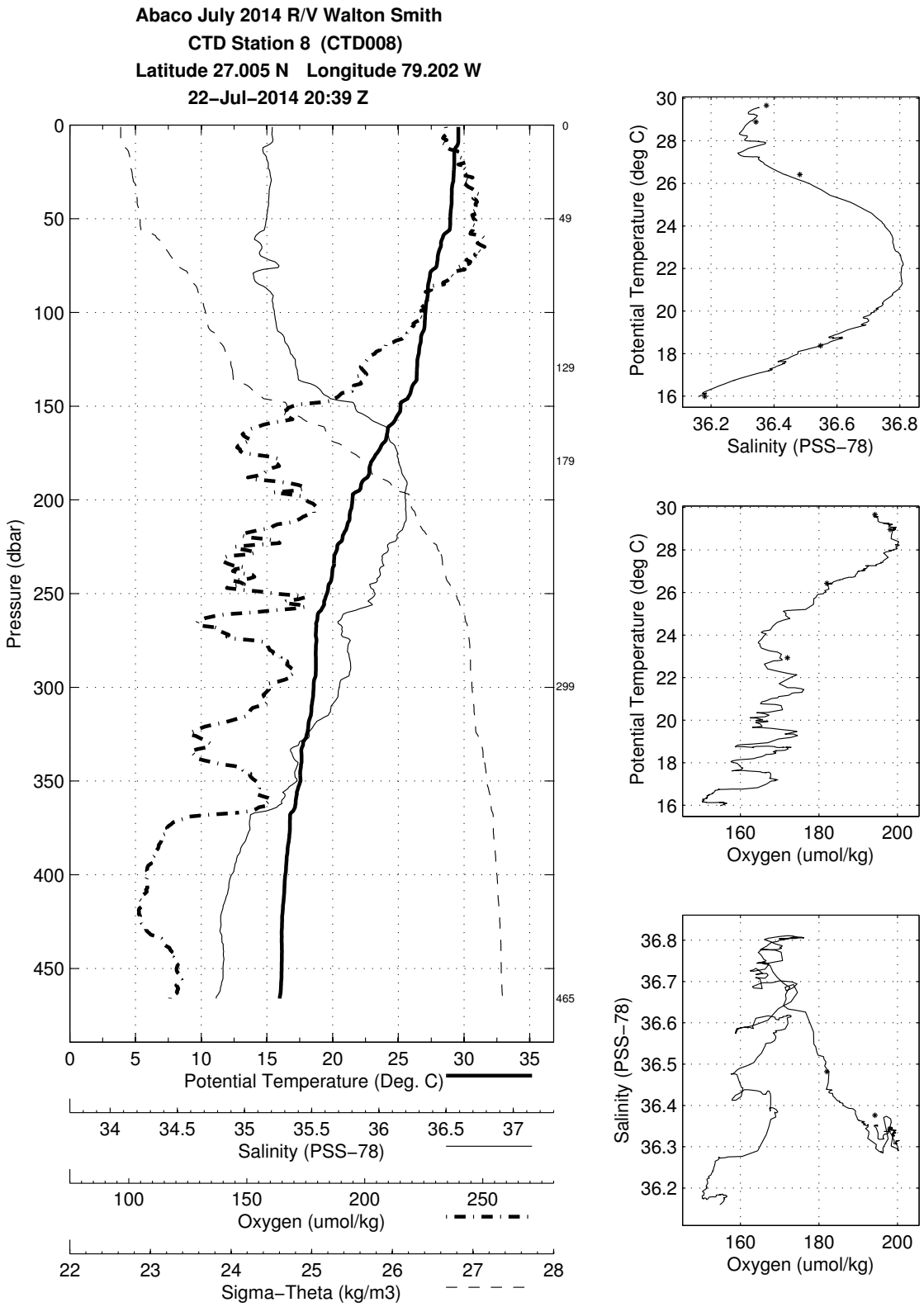
Pressure dbar	Niskin	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}
600	1	11.781	11.702	35.431	126.0
555	2	13.038	13.708	−999.000	NaN
455	3	15.102	15.607	−999.000	NaN
302	4	18.302	18.248	36.578	182.7
180	5	21.438	21.585	−999.000	NaN
130	6	26.388	26.358	36.503	183.1
49	7	28.423	28.411	36.287	205.3
1	8	29.892	29.892	36.400	196.8


Abaco July 2014 R/V Walton Smith
CTD Station 7 (CTD007)
Latitude 27.006 N Longitude 79.285 W
22−Jul−2014 21:49 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Potential Temperature (deg C)
Oxygen (umol/kg)
Salinity (PSS−78)
Oxygen (umol/kg)

Florida Straits July 2014 R/V Walton Smith
CTD Station 8 (CTD008)
Latitude 27.005N Longitude 79.202W
22-Jul-2014 20:39Z

Pressure	Temp90	PoTemp90	Salinity	Oxygen	DynHt	SigT
dbar	°C	°C	PSS-78	μmol·kg^{-1}	m^2·s^{-2}	kg·m^{-3}
1	29.560	29.560	36.351	194.9	0.005	22.889
10	29.537	29.535	36.345	194.6	0.050	22.893
20	29.261	29.256	36.337	197.7	0.099	22.982
30	29.193	29.186	36.347	198.4	0.147	23.014
50	28.965	28.953	36.331	198.9	0.244	23.079
75	27.932	27.914	36.374	197.2	0.360	23.456
100	27.073	27.050	36.358	191.4	0.467	23.725
125	26.476	26.447	36.429	183.5	0.570	23.971
150	25.196	25.163	36.633	172.6	0.665	24.526
200	21.545	21.506	36.805	174.5	0.809	25.729
250	19.615	19.568	36.702	170.1	0.916	26.175
300	18.610	18.557	36.579	169.1	1.007	26.342
400	16.459	16.394	36.211	151.7	1.174	26.588

Pressure	Niskin	Temp90	PoTemp90	Salinity	Oxygen
dbar		°C	°C	PSS-78	μmol·kg^{-1}
466	1	16.062	15.987	36.180	NaN
299	2	18.424	18.371	36.548	NaN
179	3	23.088	23.219	−999.000	NaN
130	4	26.449	26.419	36.482	182.0
50	5	28.895	28.883	36.343	198.1
0	6	29.663	29.662	36.376	194.3

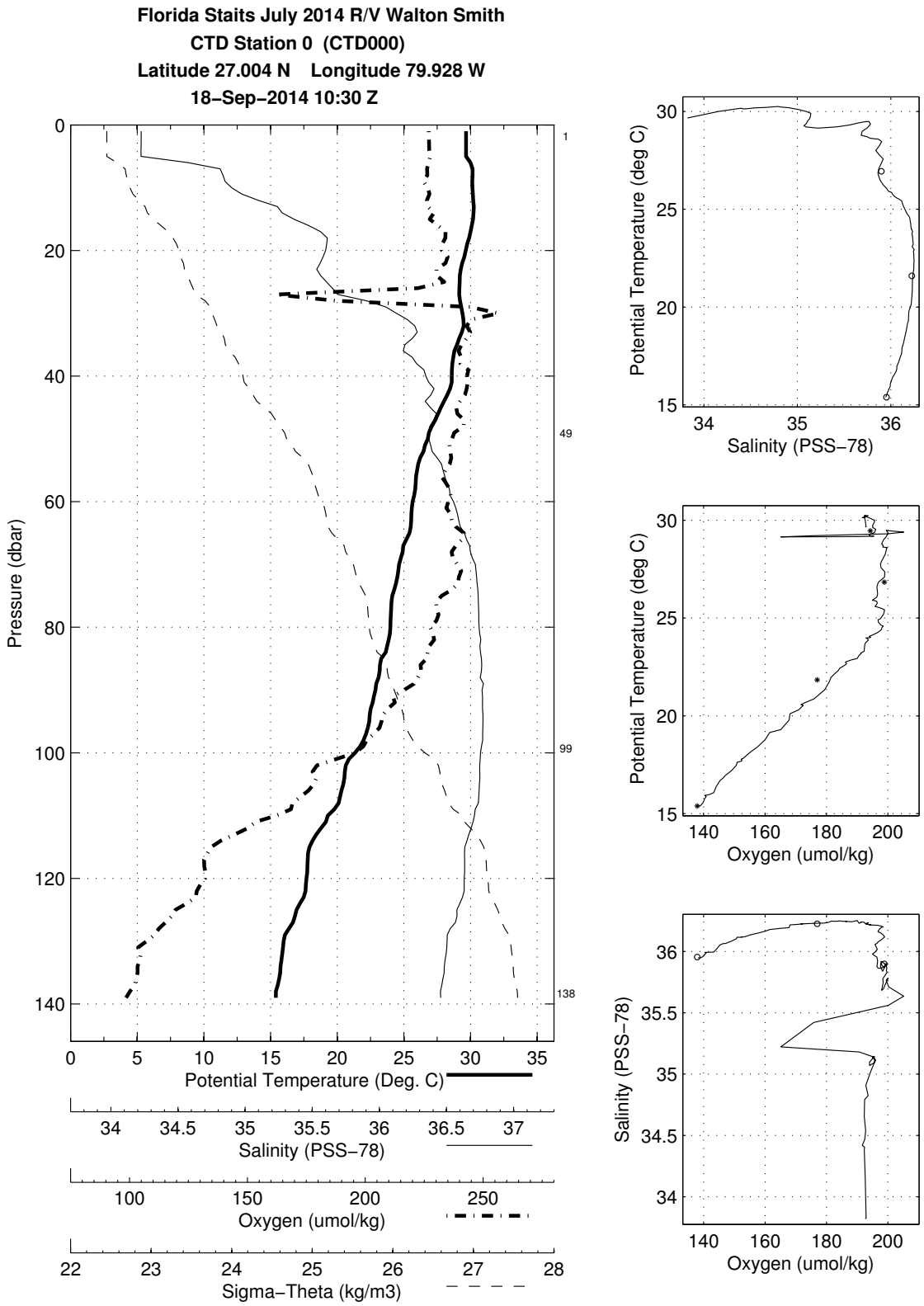

Abaco July 2014 R/V Walton Smith
CTD Station 8 (CTD008)
Latitude 27.005 N Longitude 79.202 W
22−Jul−2014 20:39 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Potential Temperature (deg C)
Oxygen (umol/kg)
Salinity (PSS−78)
Oxygen (umol/kg)

A.3 WS1414

Florida Straits 2014 R/V Walton Smith
CTD Station 0 (CTD000)
Latitude 27.004N Longitude 79.928W
18-Sep-2014 10:30Z

Pressure dbar	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}	DynHt m^2·s^{-2}	SigT kg·m^{-3}
1	29.665	29.665	33.825	193.4	0.007	20.959
10	30.146	30.144	34.468	193.2	0.067	21.278
20	29.639	29.634	35.133	195.8	0.128	21.951
30	29.399	29.392	35.636	208.0	0.185	22.410
50	26.811	26.799	35.865	197.6	0.285	23.434
75	24.145	24.129	36.216	195.7	0.382	24.524
100	21.352	21.332	36.232	180.0	0.460	25.341
125	16.976	16.955	36.065	147.2	0.512	26.343

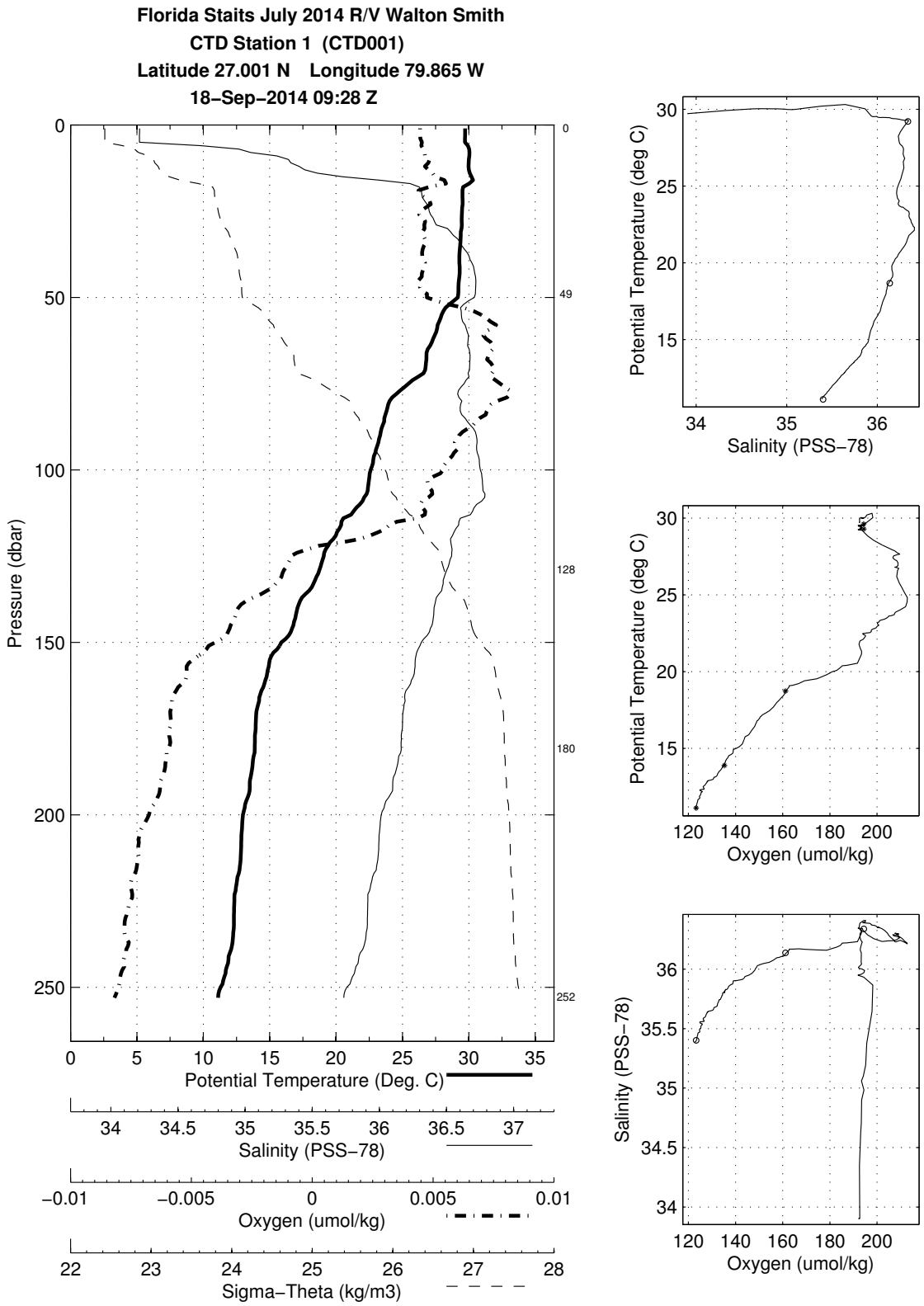
Pressure dbar	Niskin	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}
138	1	15.412	15.390	35.954	137.9
99	2	21.611	21.592	36.226	177.0
49	3	26.948	26.936	35.899	198.8
2	4	29.458	29.458	33.703	194.3


Florida Staits July 2014 R/V Walton Smith
CTD Station 0 (CTD000)
Latitude 27.004 N Longitude 79.928 W
18−Sep−2014 10:30 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Potential Temperature (deg C)
Oxygen (umol/kg)
Salinity (PSS−78)
Oxygen (umol/kg)

Florida Straits 2014 R/V Walton Smith
CTD Station 0 (CTD000)
Latitude 27.004N Longitude 79.928W
18-Sep-2014 10:30Z

Pressure dbar	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}	DynHt m^2·s^{-2}	SigT kg·m^{-3}
1	29.665	29.665	33.825	193.4	0.007	20.959
10	30.146	30.144	34.468	193.2	0.067	21.278
20	29.639	29.634	35.133	195.8	0.128	21.951
30	29.399	29.392	35.636	208.0	0.185	22.410
50	26.811	26.799	35.865	197.6	0.285	23.434
75	24.145	24.129	36.216	195.7	0.382	24.524
100	21.352	21.332	36.232	180.0	0.460	25.341
125	16.976	16.955	36.065	147.2	0.512	26.343

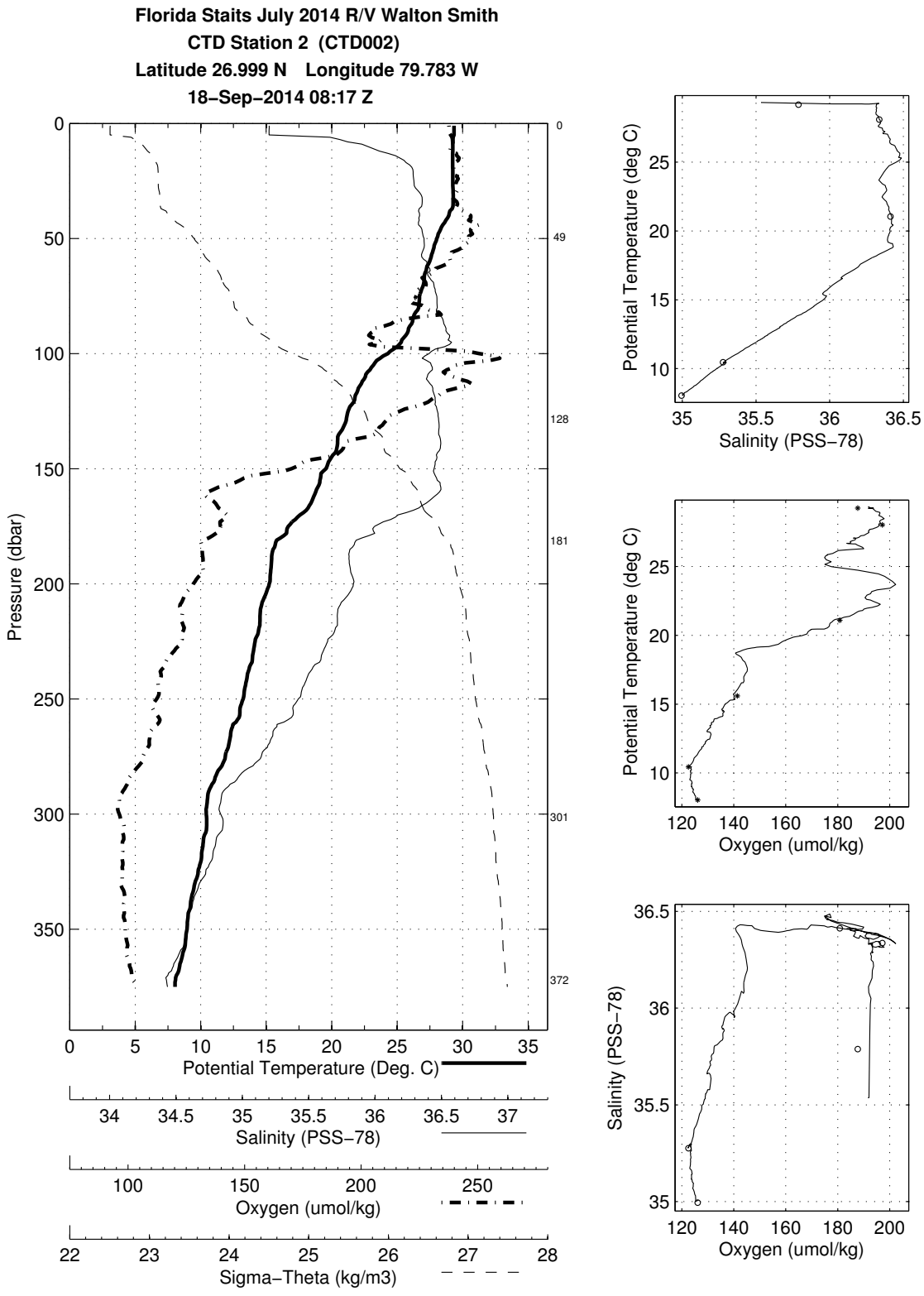
Pressure dbar	Niskin	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}
138	1	15.412	15.390	35.954	137.9
99	2	21.611	21.592	36.226	177.0
49	3	26.948	26.936	35.899	198.8
2	4	29.458	29.458	33.703	194.3


Florida Staits July 2014 R/V Walton Smith
CTD Station 1 (CTD001)
Latitude 27.001 N Longitude 79.865 W
18−Sep−2014 09:28 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Potential Temperature (deg C)
Oxygen (umol/kg)
Salinity (PSS−78)
Oxygen (umol/kg)

Florida Straits 2014 R/V Walton Smith
CTD Station 2 (CTD002)
Latitude 26.999N Longitude 79.783W
18-Sep-2014 08:17Z

Pressure dbar	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}	DynHt m^2·s^{-2}	SigT kg·m^{-3}
1	29.337	29.336	35.538	192.0	0.005	22.355
10	29.244	29.241	36.050	193.2	0.053	22.772
20	29.246	29.241	36.285	193.0	0.103	22.948
30	29.275	29.268	36.321	193.7	0.152	22.966
50	28.042	28.030	36.343	196.4	0.247	23.395
75	26.722	26.705	36.410	185.5	0.354	23.875
100	24.308	24.286	36.370	199.4	0.448	24.593
125	21.264	21.240	36.413	181.4	0.519	25.504
150	19.581	19.553	36.396	158.8	0.577	25.945
200	15.261	15.231	35.976	138.2	0.662	26.674
250	13.267	13.232	35.689	130.6	0.727	26.880
300	10.462	10.426	35.286	122.6	0.783	27.101

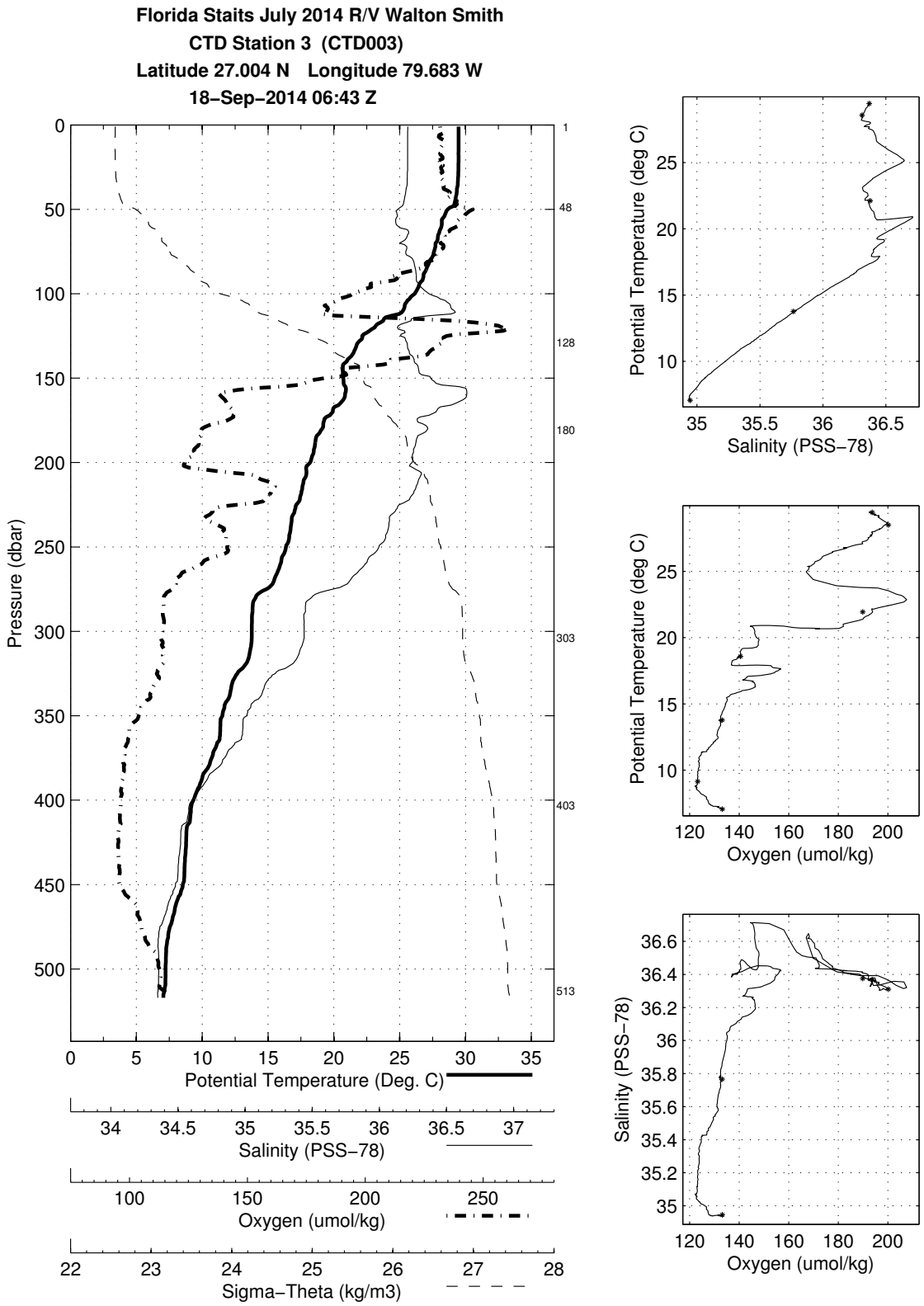
Pressure dbar	Niskin	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}
372	1	8.077	8.038	34.995	126.1
301	2	10.497	10.461	35.276	122.6
181	3	15.867	16.065	−999.000	NaN
128	4	21.073	21.049	36.413	180.8
49	5	28.116	28.105	36.337	197.2
1	6	29.187	29.187	35.788	187.7


Florida Staits July 2014 R/V Walton Smith
CTD Station 2 (CTD002)
Latitude 26.999 N Longitude 79.783 W
18−Sep−2014 08:17 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Potential Temperature (deg C)
Oxygen (umol/kg)
Salinity (PSS−78)
Oxygen (umol/kg)

Florida Straits 2014 R/V Walton Smith
CTD Station 3 (CTD003)
Latitude 27.004N Longitude 79.683W
18-Sep-2014 06:43Z

Pressure dbar	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}	DynHt m^2·s^{-2}	SigT kg·m^{-3}
1	29.469	29.469	36.375	192.8	0.005	22.938
10	29.472	29.469	36.373	193.9	0.049	22.937
20	29.474	29.469	36.373	193.5	0.098	22.937
30	29.452	29.445	36.371	193.3	0.148	22.944
50	28.659	28.647	36.316	200.4	0.245	23.171
75	27.627	27.609	36.363	193.2	0.358	23.548
100	26.170	26.147	36.495	174.2	0.461	24.115
125	22.174	22.149	36.333	193.7	0.544	25.189
150	20.746	20.718	36.505	167.8	0.607	25.717
200	18.241	18.206	36.399	137.5	0.708	26.293
250	16.399	16.358	36.208	146.6	0.789	26.594
300	13.812	13.768	35.779	132.4	0.859	26.838
400	9.369	9.324	35.134	123.0	0.972	27.171
500	7.262	7.213	34.942	131.4	1.062	27.343

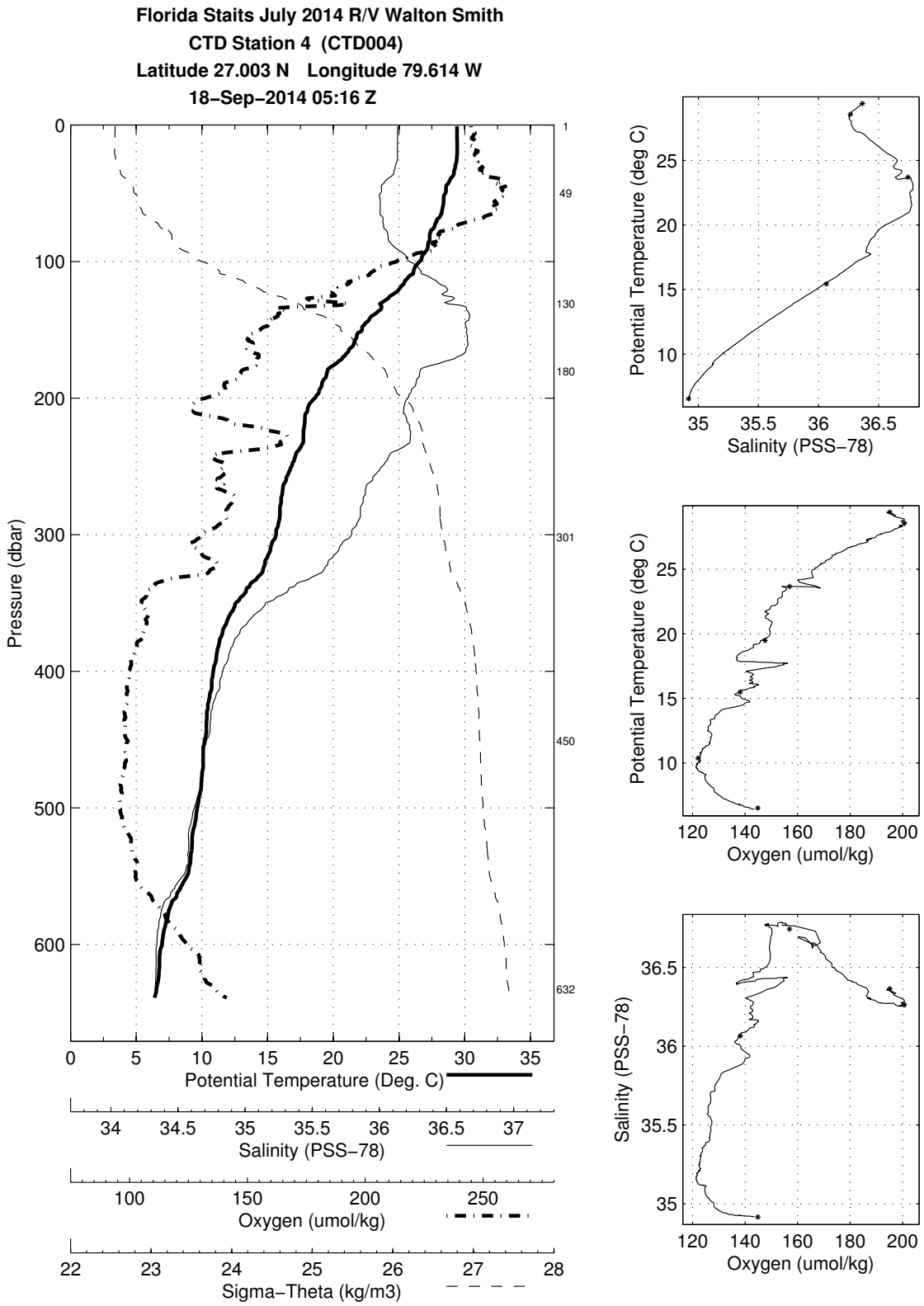
Pressure dbar	Niskin	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}
513	1	7.098	7.049	34.946	133.2
403	2	9.242	9.810	−999.000	NaN
304	3	13.807	13.763	35.766	133.1
180	4	18.644	18.816	−999.000	NaN
129	5	22.142	22.116	36.375	189.8
49	6	28.594	28.582	36.310	200.2
1	7	29.466	29.466	36.368	193.7


Florida Staits July 2014 R/V Walton Smith
CTD Station 3 (CTD003)
Latitude 27.004 N Longitude 79.683 W
18−Sep−2014 06:43 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Potential Temperature (deg C)
Oxygen (umol/kg)
Salinity (PSS−78)
Oxygen (umol/kg)

Florida Straits 2014 R/V Walton Smith
CTD Station 4 (CTD004)
Latitude 27.003N Longitude 79.614W
18-Sep-2014 05:16Z

Pressure dbar	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}	DynHt m^2·s^{-2}	SigT kg·m^{-3}
1	29.413	29.413	36.360	193.9	0.005	22.947
10	29.420	29.417	36.359	194.1	0.049	22.944
20	29.433	29.428	36.359	195.4	0.098	22.940
30	29.294	29.286	36.346	196.0	0.147	22.979
50	28.537	28.525	36.259	200.8	0.243	23.168
75	27.686	27.669	36.277	191.1	0.359	23.464
100	26.602	26.580	36.430	179.1	0.465	23.929
125	24.390	24.363	36.637	166.4	0.555	24.772
150	22.219	22.189	36.770	150.8	0.625	25.510
200	18.641	18.605	36.420	139.0	0.733	26.208
250	16.856	16.815	36.268	143.2	0.817	26.532
300	15.689	15.642	36.086	138.7	0.892	26.665
400	10.914	10.864	35.322	123.1	1.017	27.051
500	9.706	9.648	35.152	121.5	1.125	27.130
600	7.015	6.957	34.930	135.3	1.218	27.369

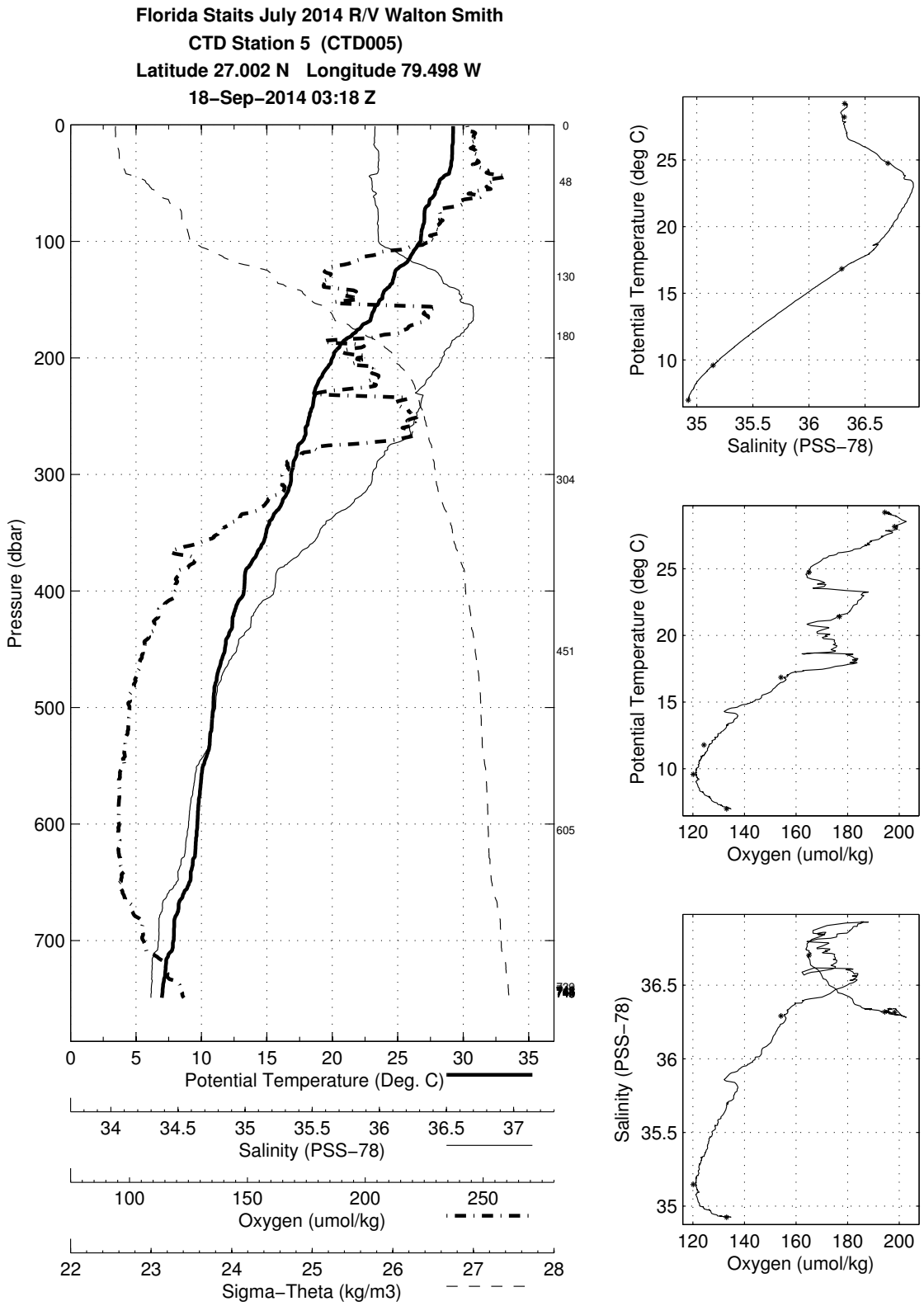
Pressure dbar	Niskin	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}
633	1	6.601	6.542	34.917	144.8
451	2	10.425	11.031	−999.000	NaN
302	3	15.482	15.434	36.066	138.1
180	4	19.486	19.651	−999.000	NaN
131	5	23.727	23.699	36.744	156.9
50	6	28.581	28.569	36.265	200.6
1	7	29.403	29.403	36.365	195.1


Florida Staits July 2014 R/V Walton Smith
CTD Station 4 (CTD004)
Latitude 27.003 N Longitude 79.614 W
18−Sep−2014 05:16 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Potential Temperature (deg C)
Oxygen (umol/kg)
Salinity (PSS−78)
Oxygen (umol/kg)

Florida Straits 2014 R/V Walton Smith
CTD Station 5 (CTD005)
Latitude 27.002N Longitude 79.498W
18-Sep-2014 03:18Z

Pressure dbar	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}	DynHt m^2·s^{-2}	SigT kg·m^{-3}
1	29.231	29.231	36.319	194.1	0.005	22.977
10	29.226	29.224	36.317	195.4	0.049	22.978
20	29.163	29.158	36.324	194.9	0.098	23.005
30	29.150	29.143	36.343	196.1	0.146	23.025
50	28.172	28.160	36.300	198.9	0.241	23.320
75	27.060	27.043	36.337	188.7	0.351	23.712
100	26.776	26.753	36.339	187.5	0.455	23.806
125	24.858	24.830	36.692	164.8	0.549	24.673
150	23.698	23.667	36.846	171.3	0.627	25.139
200	20.044	20.006	36.735	171.5	0.747	26.084
250	18.307	18.263	36.579	184.0	0.837	26.416
300	16.908	16.858	36.301	155.7	0.919	26.547
400	13.297	13.240	35.689	133.1	1.062	26.878
500	10.973	10.910	35.326	123.5	1.180	27.046
600	9.757	9.687	35.156	121.6	1.290	27.127
700	7.947	7.874	34.970	126.7	1.391	27.269

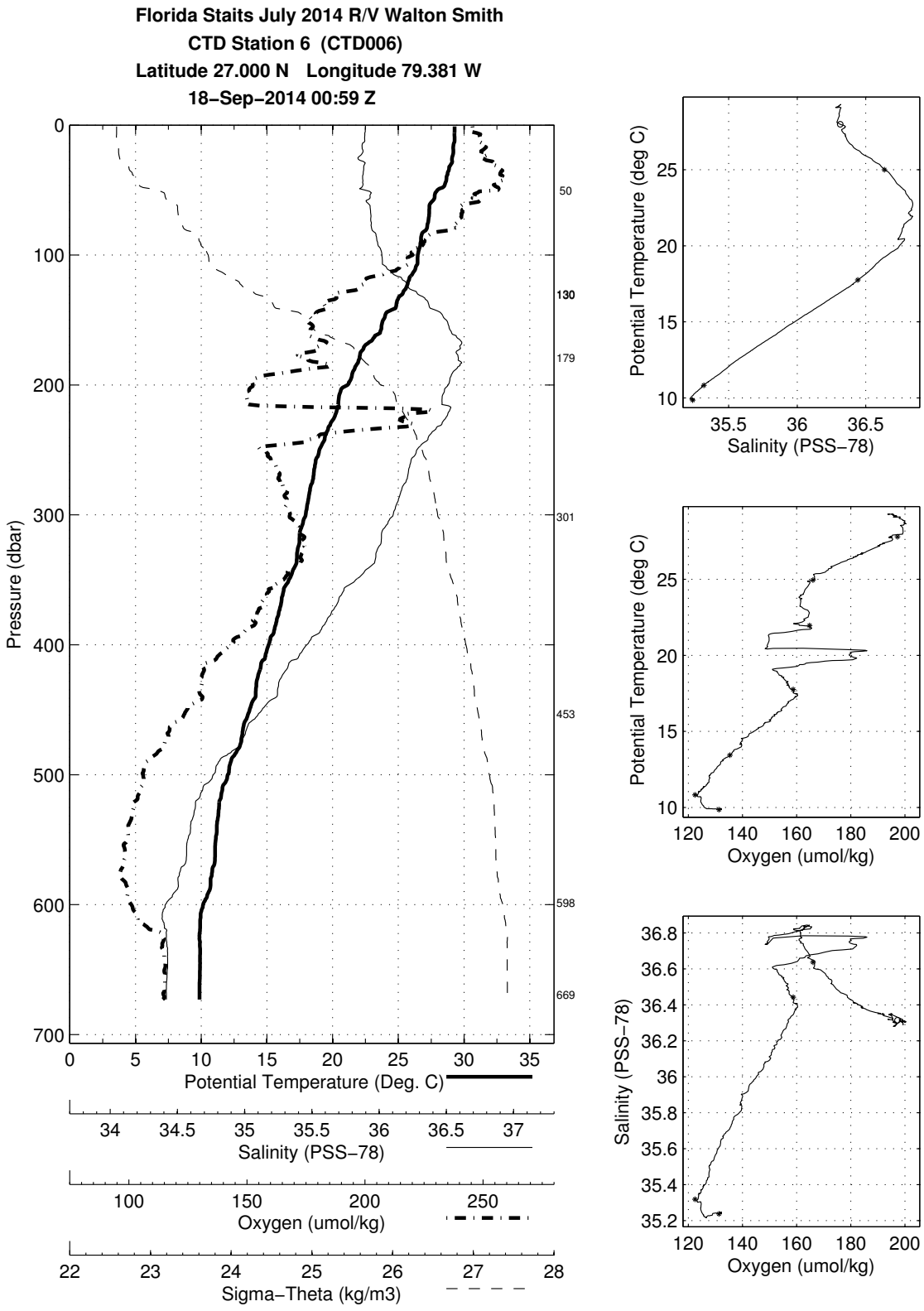
Pressure dbar	Niskin	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}
745	1	7.062	6.989	34.924	133.1
745	2	7.057	8.164	−999.000	NaN
745	3	7.059	8.166	−999.000	NaN
745	4	7.067	8.173	−999.000	NaN
744	5	7.071	8.176	−999.000	NaN
744	6	7.075	8.179	−999.000	NaN
744	7	7.080	8.184	−999.000	NaN
743	8	7.083	8.186	−999.000	NaN
743	9	7.083	8.187	−999.000	NaN
743	10	7.087	8.190	−999.000	NaN
743	11	7.088	8.191	−999.000	NaN
743	12	7.086	8.189	−999.000	NaN
743	13	7.089	8.192	−999.000	NaN
743	14	7.091	8.194	−999.000	NaN
743	15	7.094	8.197	−999.000	NaN
742	16	7.104	8.204	−999.000	NaN
740	17	7.119	8.215	−999.000	NaN
605	18	9.662	9.592	35.146	120.1
452	19	11.803	12.379	−999.000	NaN
304	20	16.881	16.830	36.291	154.2
181	21	21.436	21.584	−999.000	NaN
130	22	24.776	24.748	36.703	165.0
49	23	28.222	28.210	36.315	198.2
1	24	29.220	29.220	36.318	194.4


Florida Staits July 2014 R/V Walton Smith
CTD Station 5 (CTD005)
Latitude 27.002 N Longitude 79.498 W
18−Sep−2014 03:18 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Potential Temperature (deg C)
Oxygen (umol/kg)
Salinity (PSS−78)
Oxygen (umol/kg)

Florida Straits 2014 R/V Walton Smith
CTD Station 6 (CTD006)
Latitude 27.000N Longitude 79.381W
18-Sep-2014 00:59Z

Pressure dbar	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}	DynHt m^2·s^{-2}	SigT kg·m^{-3}
1	29.279	29.278	36.321	193.4	0.005	22.962
10	29.279	29.277	36.316	194.6	0.049	22.959
20	29.192	29.187	36.308	195.3	0.098	22.983
30	29.019	29.011	36.316	197.4	0.146	23.049
50	27.977	27.966	36.319	198.8	0.241	23.398
75	27.291	27.273	36.353	190.8	0.349	23.649
100	26.502	26.480	36.410	182.0	0.452	23.946
125	25.630	25.602	36.554	171.7	0.548	24.330
150	23.873	23.842	36.758	160.9	0.631	25.020
200	21.178	21.139	36.767	149.8	0.759	25.802
250	19.038	18.993	36.599	151.4	0.860	26.246
300	17.997	17.945	36.470	157.3	0.949	26.412
400	15.187	15.125	36.001	145.1	1.108	26.716
500	12.085	12.018	35.493	127.7	1.241	26.968
600	10.221	10.149	35.232	125.5	1.357	27.108

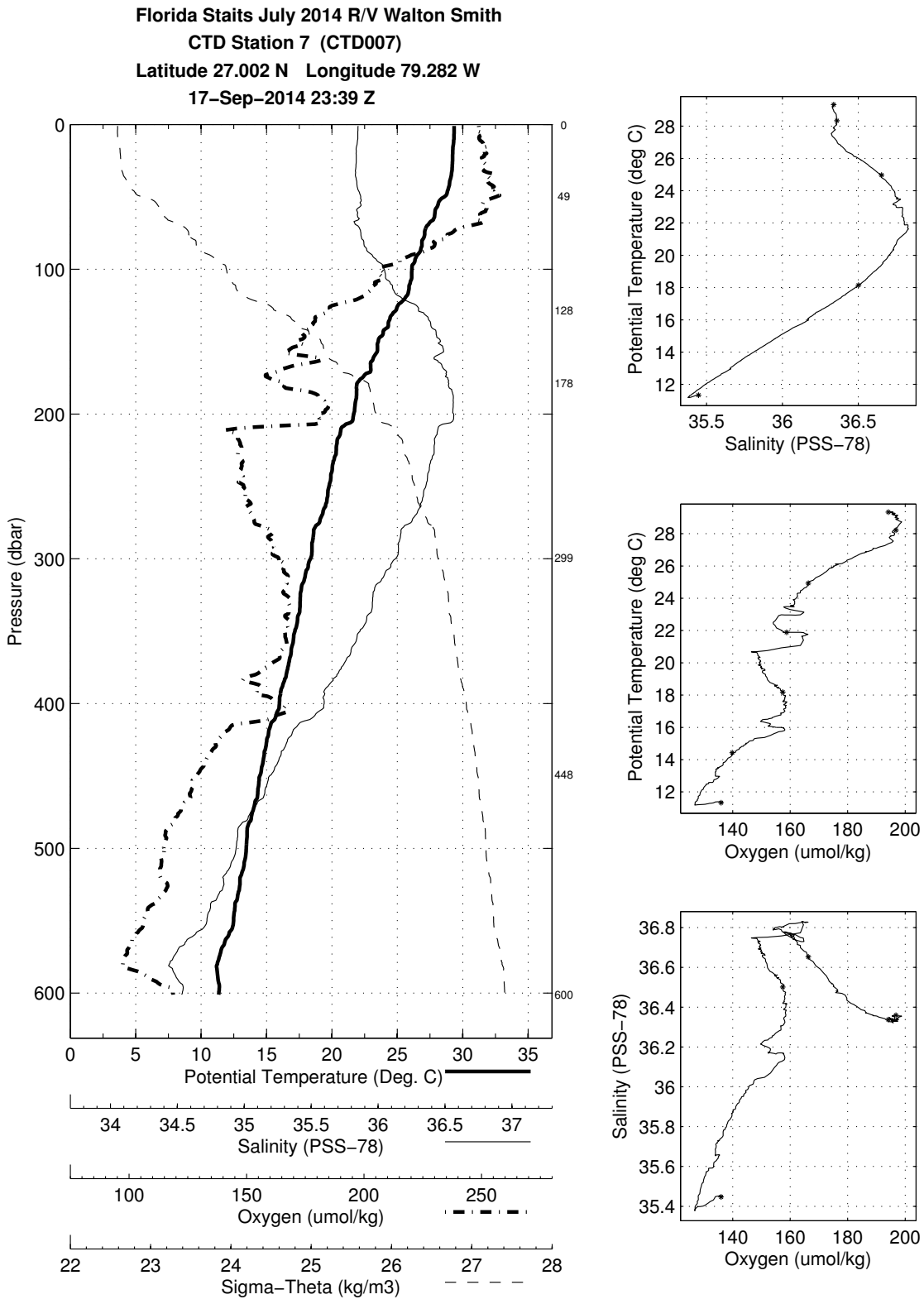
Pressure dbar	Niskin	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}
670	1	9.937	9.858	35.237	131.3
599	2	10.903	10.828	35.319	122.4
453	3	13.502	14.042	−999.000	NaN
301	4	17.811	17.759	36.442	158.7
179	5	22.003	22.144	−999.000	NaN
130	6	25.024	24.995	36.637	166.0
131	7	25.030	25.113	−999.000	NaN
50	8	27.998	27.986	36.314	197.2


Florida Staits July 2014 R/V Walton Smith
CTD Station 6 (CTD006)
Latitude 27.000 N Longitude 79.381 W
18−Sep−2014 00:59 Z
Pressure (dbar)
0
100
200
300
400
500
600
700
50
130
179
301
453
598
669
0 5 10 15 20 25 30 35
Potential Temperature (Deg. C)
34 34.5 35 35.5 36 36.5 37
Salinity (PSS−78)
100 150 200 250
Oxygen (umol/kg)
22 23 24 25 26 27 28
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
10 15 20 25
35.5 36 36.5
Salinity (PSS−78)
Potential Temperature (deg C)
10 15 20 25
120 140 160 180 200
Oxygen (umol/kg)
Salinity (PSS−78)
35.2 35.4 35.6 35.8 36 36.2 36.4 36.6 36.8
120 140 160 180 200
Oxygen (umol/kg)

Florida Straits 2014 R/V Walton Smith
CTD Station 7 (CTD007)
Latitude 27.002N Longitude 79.282W
17-Sep-2014 23:39Z

Pressure dbar	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}	DynHt m^2·s^{-2}	SigT kg·m^{-3}
1	29.339	29.339	36.343	193.9	0.005	22.959
10	29.335	29.333	36.341	194.1	0.049	22.960
20	29.237	29.232	36.333	195.6	0.098	22.987
30	29.202	29.194	36.331	195.7	0.147	22.999
50	28.599	28.587	36.356	197.5	0.243	23.221
75	27.107	27.090	36.357	189.1	0.353	23.711
100	26.139	26.116	36.476	175.8	0.454	24.111
125	25.071	25.044	36.640	166.3	0.547	24.568
150	23.574	23.542	36.762	159.8	0.625	25.112
200	21.700	21.660	36.829	164.2	0.755	25.704
250	19.825	19.779	36.687	149.7	0.861	26.108
300	18.422	18.369	36.532	156.5	0.955	26.354
400	16.054	15.990	36.169	157.4	1.119	26.650
500	13.527	13.456	35.720	134.6	1.260	26.858
600	11.434	11.356	35.446	136.4	1.384	27.057

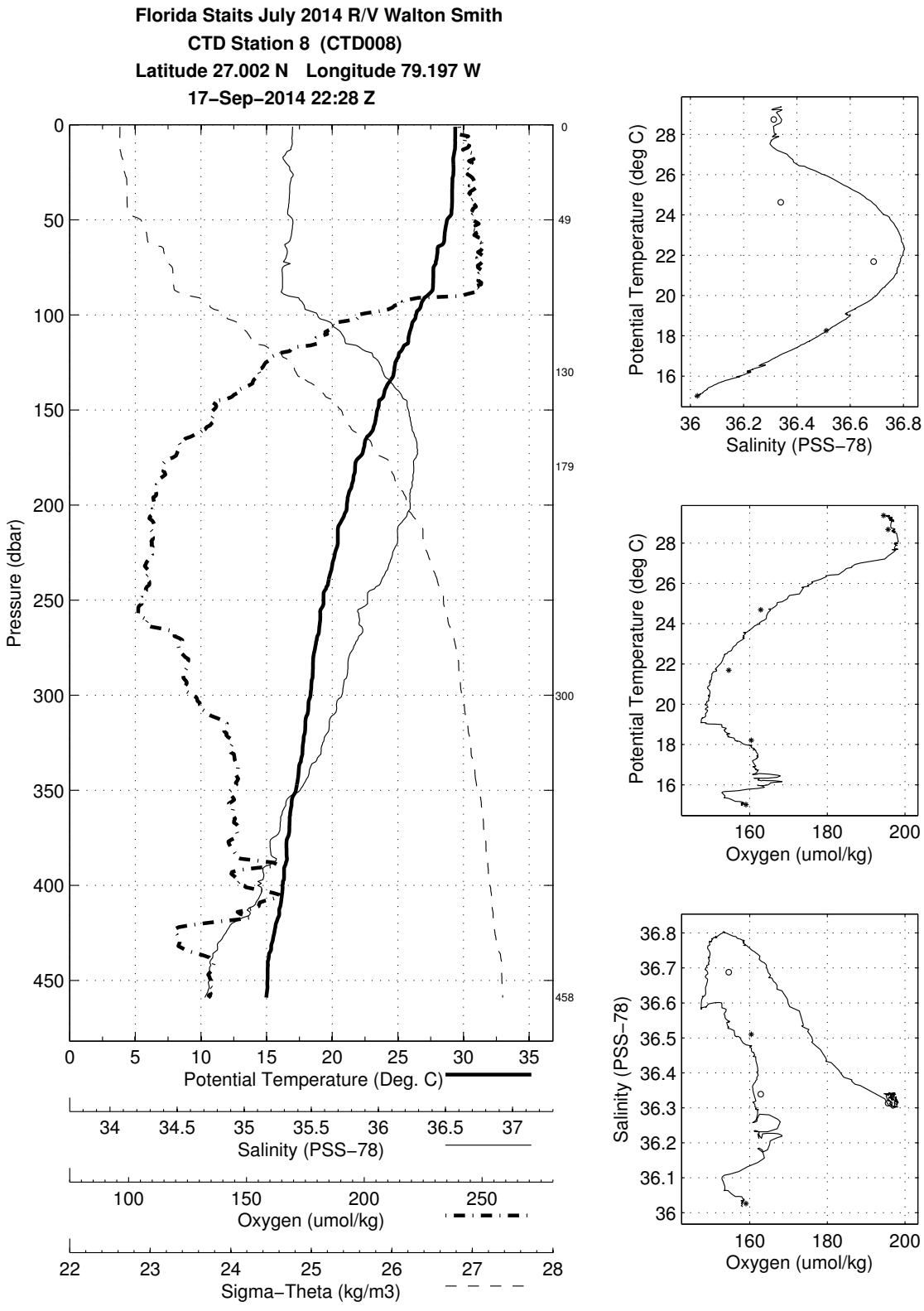
Pressure dbar	Niskin	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}
601	1	11.408	11.331	35.447	136.0
449	2	14.524	15.037	−999.000	NaN
299	3	18.203	18.150	36.501	157.4
179	4	21.925	22.066	−999.000	NaN
129	5	24.993	24.965	36.653	166.3
50	6	28.352	28.341	36.359	196.8
1	7	29.337	29.337	36.338	194.2


Florida Staits July 2014 R/V Walton Smith
CTD Station 7 (CTD007)
Latitude 27.002 N Longitude 79.282 W
17−Sep−2014 23:39 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Potential Temperature (deg C)
Oxygen (umol/kg)
Salinity (PSS−78)
Oxygen (umol/kg)

Florida Straits 2014 R/V Walton Smith
CTD Station 8 (CTD008)
Latitude 27.002N Longitude 79.197W
17-Sep-2014 22:28Z

Pressure	Temp90	PoTemp90	Salinity	Oxygen	DynHt	SigT
dbar	°C	°C	PSS-78	μmol·kg^{-1}	m^2·s^{-2}	kg·m^{-3}
1	29.369	29.368	36.342	193.5	0.005	22.948
10	29.366	29.364	36.340	194.1	0.049	22.948
20	29.225	29.221	36.317	195.5	0.098	22.979
30	29.157	29.150	36.334	196.0	0.147	23.016
50	28.758	28.746	36.342	195.7	0.244	23.157
75	27.733	27.716	36.304	196.7	0.359	23.469
100	26.401	26.379	36.433	179.0	0.466	23.996
125	24.833	24.806	36.661	165.7	0.557	24.656
150	23.457	23.426	36.770	158.1	0.635	25.152
200	21.153	21.114	36.776	149.5	0.761	25.815
250	19.378	19.333	36.618	147.3	0.864	26.172
300	18.394	18.341	36.523	155.1	0.956	26.353
400	16.266	16.201	36.212	162.7	1.120	26.634

Pressure	Niskin	Temp90	PoTemp90	Salinity	Oxygen
dbar		°C	°C	PSS-78	μmol·kg^{-1}
459	1	15.086	15.016	36.026	159.0
300	2	18.306	18.254	36.510	160.4
180	3	21.719	21.684	36.688	154.6
130	4	24.653	24.625	36.339	162.9
50	5	28.754	28.742	36.313	195.6
1	6	29.303	29.304	−999.000	NaN

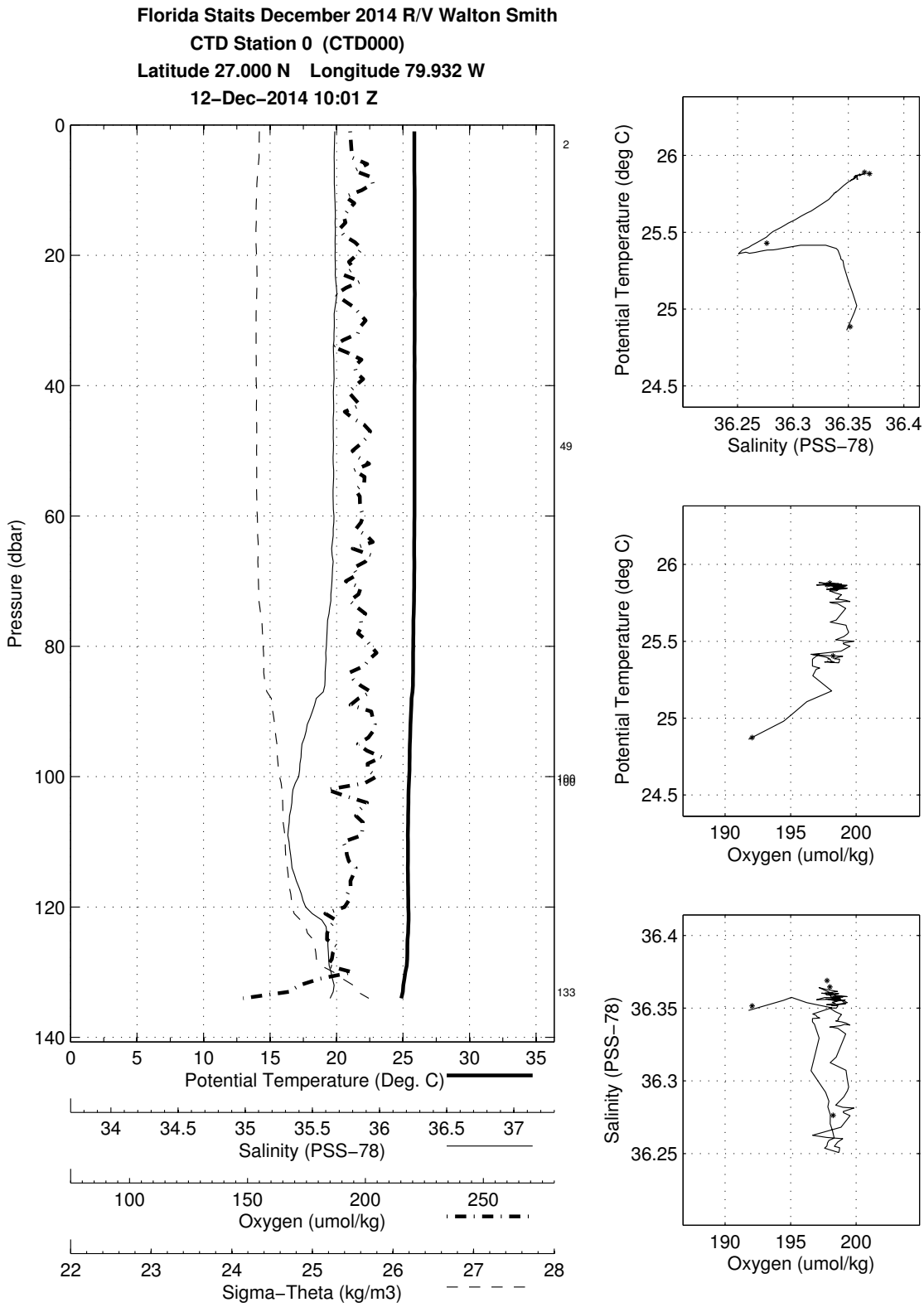

Florida Staits July 2014 R/V Walton Smith
CTD Station 8 (CTD008)
Latitude 27.002 N Longitude 79.197 W
17−Sep−2014 22:28 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Potential Temperature (deg C)
Oxygen (umol/kg)
Salinity (PSS−78)
Oxygen (umol/kg)

A.4 WS1419

Florida Straits 2014 R/V Walton Smith
CTD Station 0 (CTD000)
Latitude 27.000N Longitude 79.932W
12-Dec-2014 10:01Z

Pressure dbar	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}	DynHt m^2·s^{-2}	SigT kg·m^{-3}
1	25.846	25.846	36.359	198.0	0.004	24.107
10	25.870	25.868	36.359	198.7	0.038	24.100
20	25.876	25.871	36.360	198.4	0.076	24.100
30	25.879	25.872	36.358	198.9	0.114	24.098
50	25.873	25.862	36.356	198.1	0.191	24.100
75	25.820	25.803	36.346	198.9	0.287	24.111
100	25.491	25.469	36.276	199.5	0.382	24.162
125	25.366	25.338	36.343	196.7	0.476	24.253

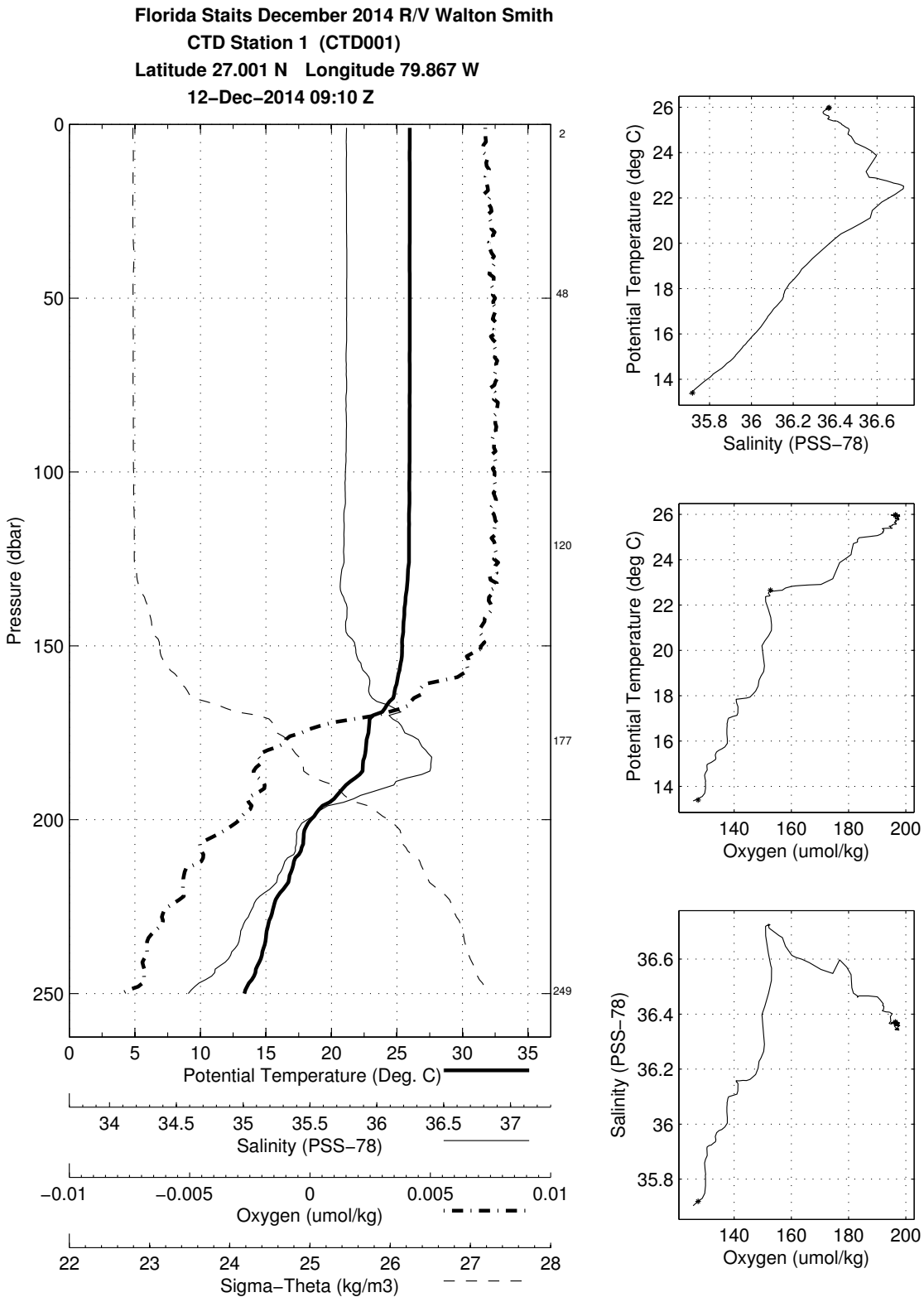
Pressure dbar	Niskin	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}
133	1	24.915	24.886	36.352	192.1
100	2	25.460	25.522	−999.000	NaN
101	3	25.451	25.428	36.276	198.2
49	4	25.892	25.881	36.369	197.8
3	5	25.891	25.891	36.365	198.0


Florida Staits December 2014 R/V Walton Smith
CTD Station 0 (CTD000)
Latitude 27.000 N Longitude 79.932 W
12−Dec−2014 10:01 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Oxygen (umol/kg)

Florida Straits 2014 R/V Walton Smith
CTD Station 1 (CTD001)
Latitude 27.001N Longitude 79.867W
12-Dec-2014 09:10Z

Pressure dbar	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}	DynHt m^2·s^{-2}	SigT kg·m^{-3}
1	25.982	25.982	36.369	195.4	0.004	24.072
10	25.974	25.971	36.368	195.8	0.038	24.075
20	25.986	25.982	36.368	195.2	0.077	24.072
30	25.989	25.982	36.369	196.6	0.115	24.072
50	25.990	25.979	36.369	197.3	0.192	24.074
75	25.998	25.981	36.369	197.1	0.289	24.073
100	25.975	25.952	36.364	197.2	0.385	24.078
125	25.949	25.921	36.358	197.0	0.482	24.083
150	25.429	25.396	36.405	194.6	0.577	24.282
200	18.458	18.423	36.204	148.3	0.723	26.089
250	13.393	13.357	35.704	125.6	0.801	26.865

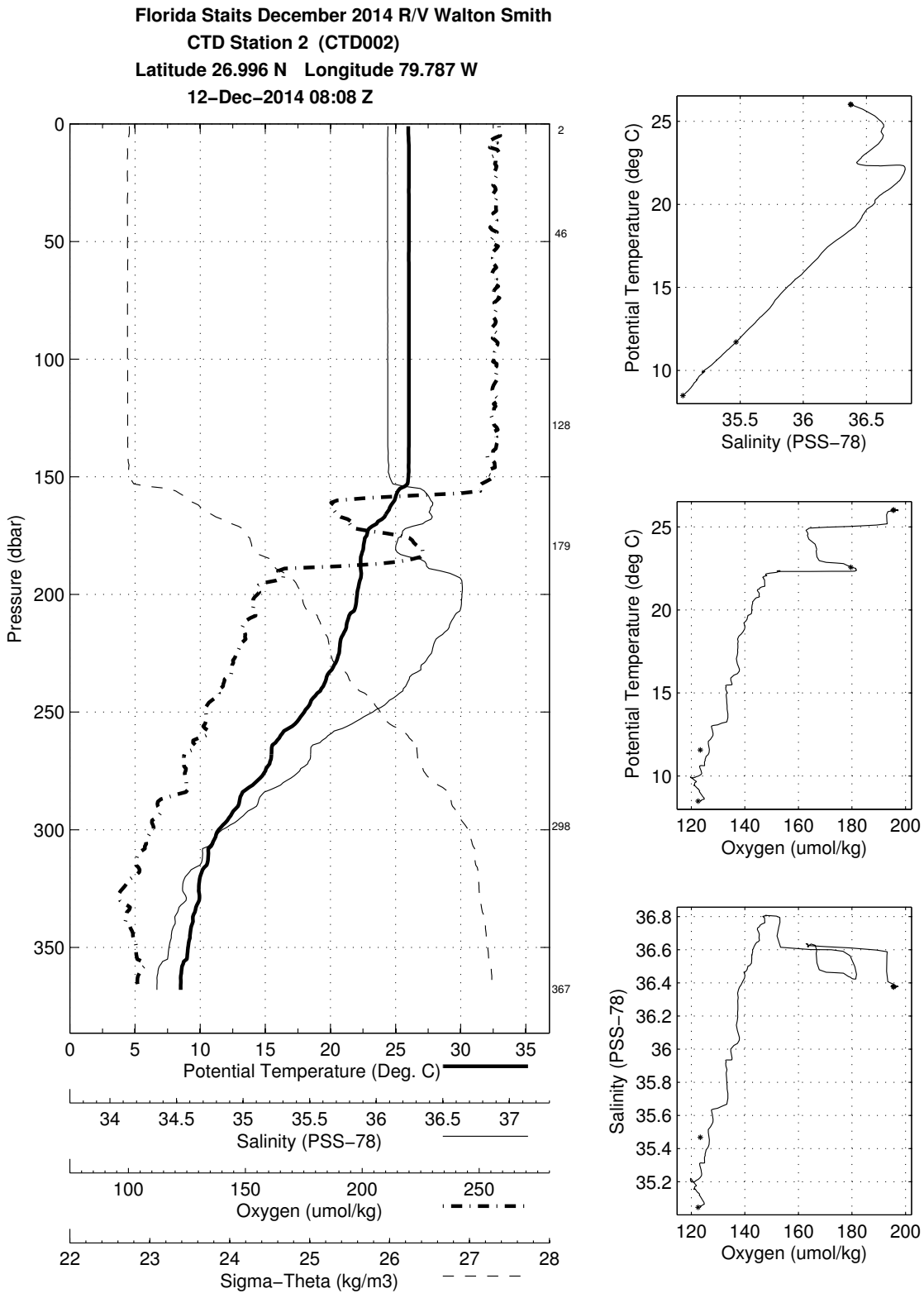
Pressure dbar	Niskin	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}
249	1	13.438	13.403	35.719	127.4
177	2	22.748	22.881	−999.000	NaN
121	3	25.995	25.968	36.369	196.5
49	4	26.000	25.989	36.371	196.5
3	5	25.987	25.986	36.371	196.4


Florida Staits December 2014 R/V Walton Smith
CTD Station 1 (CTD001)
Latitude 27.001 N Longitude 79.867 W
12−Dec−2014 09:10 Z
Pressure (dbar)
0
50
100
150
200
250
2
48
120
177
249
0 5 10 15 20 25 30 35
Potential Temperature (Deg. C)
34 34.5 35 35.5 36 36.5 37
Salinity (PSS−78)
−0.01 −0.005 0 0.005 0.01
Oxygen (umol/kg)
22 23 24 25 26 27 28
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
26 24 22 20 18 16 14
35.8 36 36.2 36.4 36.6
Salinity (PSS−78)
Potential Temperature (deg C)
26 24 22 20 18 16 14
140 160 180 200
Oxygen (umol/kg)
Salinity (PSS−78)
36.6 36.4 36.2 36 35.8
140 160 180 200
Oxygen (umol/kg)

Florida Straits 2014 R/V Walton Smith
CTD Station 2 (CTD002)
Latitude 26.996N Longitude 79.787W
12-Dec-2014 08:08Z

Pressure dbar	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}	DynHt m^2·s^{-2}	SigT kg·m^{-3}
1	25.976	25.976	36.379	197.0	0.004	24.082
10	26.023	26.021	36.377	195.1	0.038	24.066
20	26.029	26.024	36.377	196.2	0.077	24.065
30	26.026	26.020	36.377	195.7	0.115	24.067
50	26.033	26.022	36.378	195.9	0.192	24.066
75	26.040	26.023	36.378	196.6	0.289	24.066
100	26.045	26.023	36.378	196.1	0.386	24.066
125	26.047	26.019	36.378	195.6	0.483	24.067
150	26.016	25.983	36.389	195.9	0.581	24.088
200	22.085	22.045	36.805	147.8	0.731	25.577
250	18.033	17.990	36.292	137.4	0.841	26.265
300	11.446	11.408	35.426	126.7	0.913	27.032

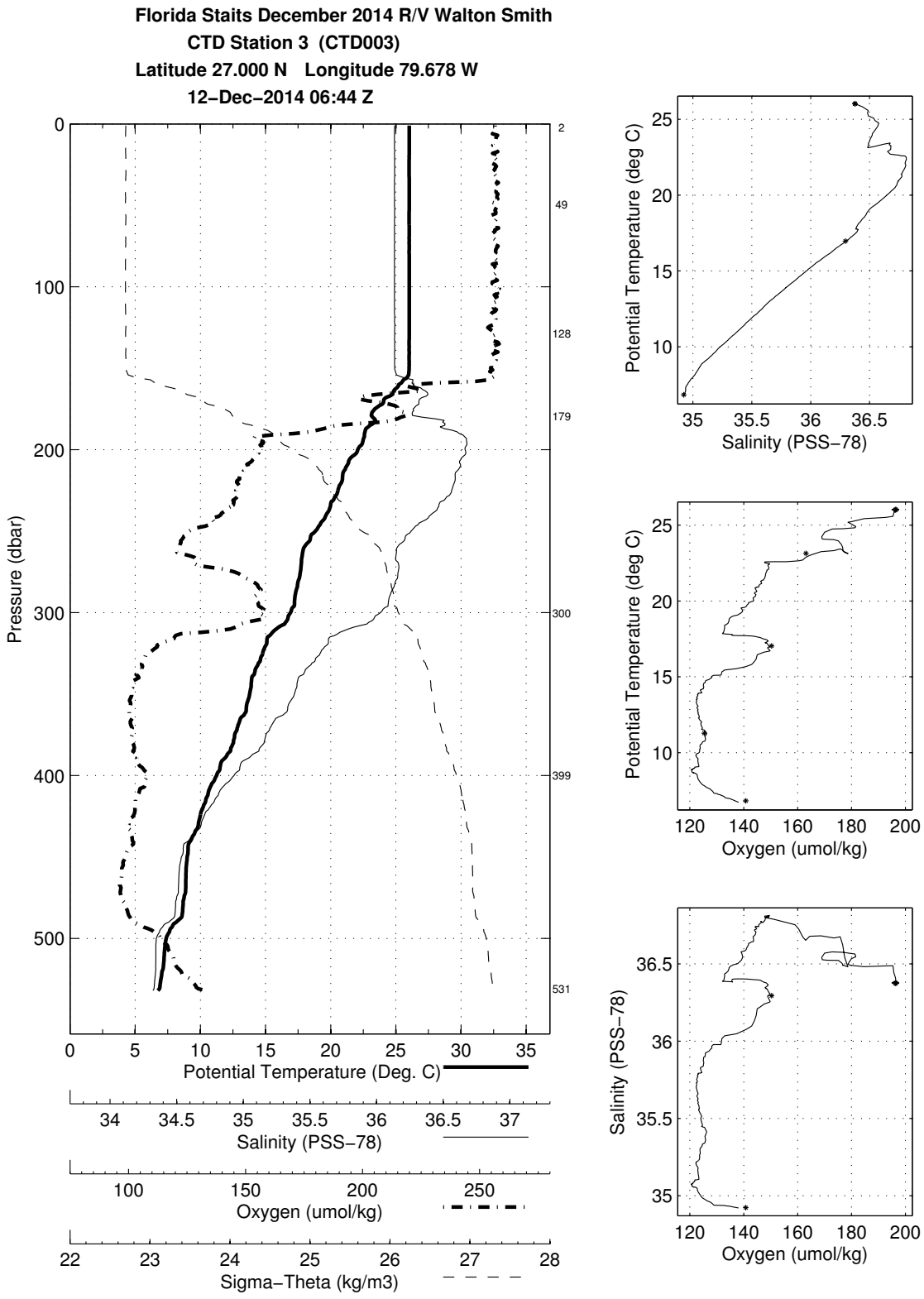
Pressure dbar	Niskin	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}
368	1	8.526	8.487	35.046	122.6
298	2	11.748	11.709	35.468	123.4
179	3	22.567	22.703	−999.000	NaN
128	4	26.050	26.022	36.376	204.8
47	5	26.027	26.016	36.375	195.6
3	6	26.006	26.005	36.378	195.5


Florida Staits December 2014 R/V Walton Smith
CTD Station 2 (CTD002)
Latitude 26.996 N Longitude 79.787 W
12−Dec−2014 08:08 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Potential Temperature (deg C)
Oxygen (umol/kg)
Salinity (PSS−78)
Oxygen (umol/kg)

Florida Straits 2014 R/V Walton Smith
CTD Station 3 (CTD003)
Latitude 27.000N Longitude 79.678W
12-Dec-2014 06:44Z

Pressure dbar	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}	DynHt m^2·s^{-2}	SigT kg·m^{-3}
1	26.023	26.023	36.377	196.5	0.004	24.066
10	26.029	26.026	36.376	196.6	0.038	24.064
20	26.025	26.021	36.377	196.4	0.077	24.066
30	26.025	26.018	36.377	196.8	0.115	24.067
50	26.040	26.028	36.377	196.9	0.193	24.064
75	26.040	26.023	36.376	197.1	0.289	24.065
100	26.047	26.025	36.376	197.3	0.386	24.064
125	26.050	26.022	36.378	195.0	0.484	24.066
150	26.054	26.020	36.377	195.6	0.581	24.067
200	22.120	22.080	36.802	149.1	0.738	25.565
250	18.861	18.816	36.476	134.6	0.846	26.197
300	16.967	16.917	36.291	148.9	0.931	26.526
400	11.293	11.242	35.409	126.2	1.063	27.050
500	7.430	7.380	34.941	128.7	1.161	27.319

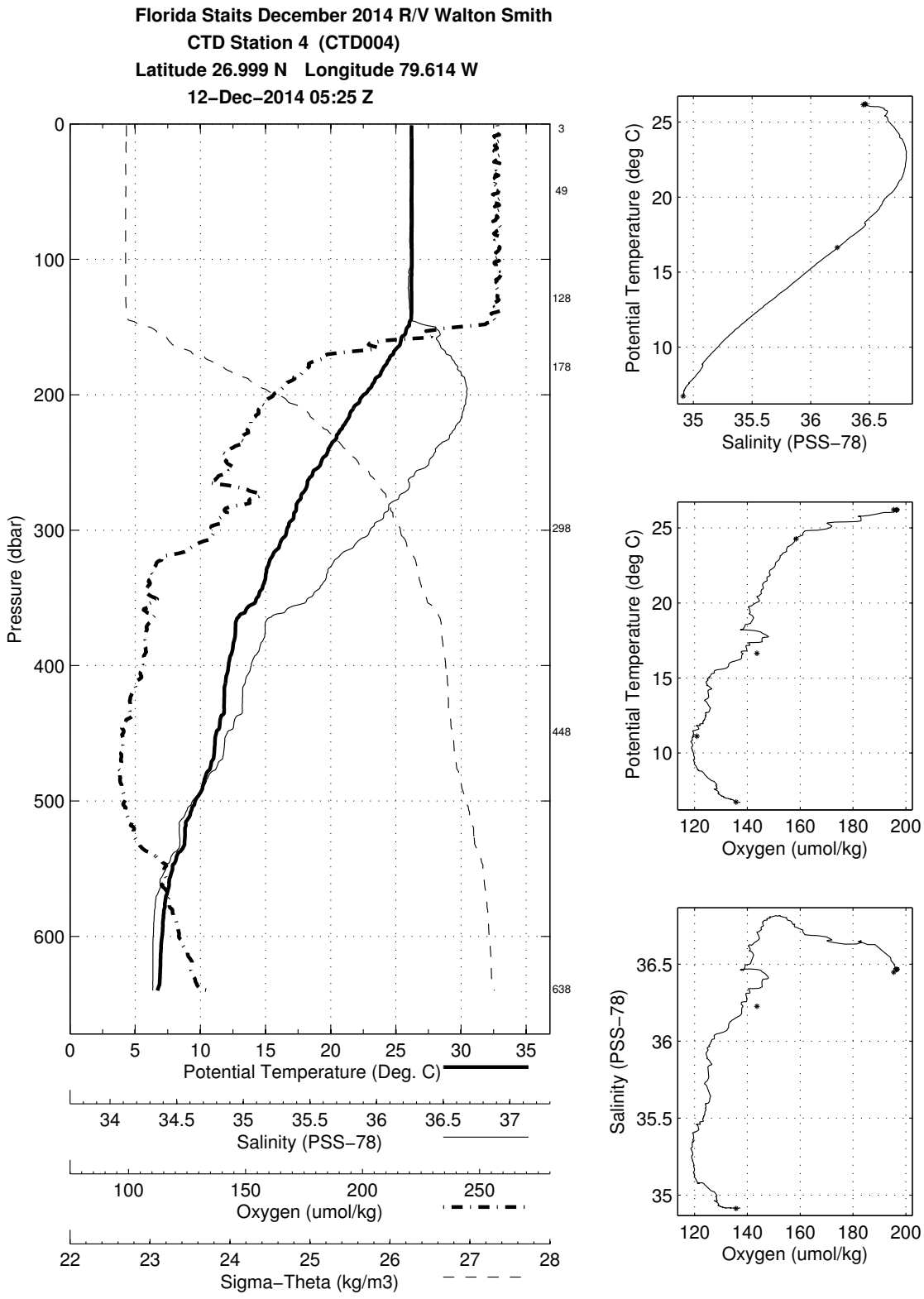
Pressure dbar	Niskin	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}
531	1	6.888	6.837	34.923	140.8
400	2	11.318	11.839	−999.000	NaN
300	3	17.015	16.965	36.295	150.3
179	4	23.640	23.767	−999.000	NaN
129	5	26.055	26.026	36.375	196.2
49	6	26.034	26.023	36.376	196.5
2	7	26.015	26.014	36.376	196.3


Florida Staits December 2014 R/V Walton Smith
CTD Station 3 (CTD003)
Latitude 27.000 N Longitude 79.678 W
12−Dec−2014 06:44 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Oxygen (umol/kg)

Florida Straits 2014 R/V Walton Smith
CTD Station 4 (CTD004)
Latitude 26.999N Longitude 79.614W
12-Dec-2014 05:25Z

Pressure dbar	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}	DynHt m^2·s^{-2}	SigT kg·m^{-3}
1	26.212	26.211	36.475	196.6	0.004	24.080
10	26.214	26.212	36.473	196.2	0.038	24.079
20	26.222	26.217	36.474	196.0	0.077	24.077
30	26.234	26.227	36.471	196.8	0.115	24.073
50	26.235	26.223	36.472	196.8	0.192	24.075
75	26.242	26.225	36.471	197.0	0.289	24.073
100	26.256	26.234	36.474	195.8	0.385	24.072
125	26.231	26.203	36.464	196.8	0.482	24.074
150	25.935	25.902	36.628	188.3	0.579	24.293
200	22.573	22.532	36.815	150.5	0.738	25.446
250	19.301	19.255	36.586	140.9	0.850	26.168
300	16.683	16.633	36.230	138.3	0.936	26.546
400	12.222	12.168	35.511	123.4	1.072	26.954
500	9.658	9.600	35.156	119.9	1.186	27.142
600	7.123	7.065	34.919	131.0	1.276	27.346

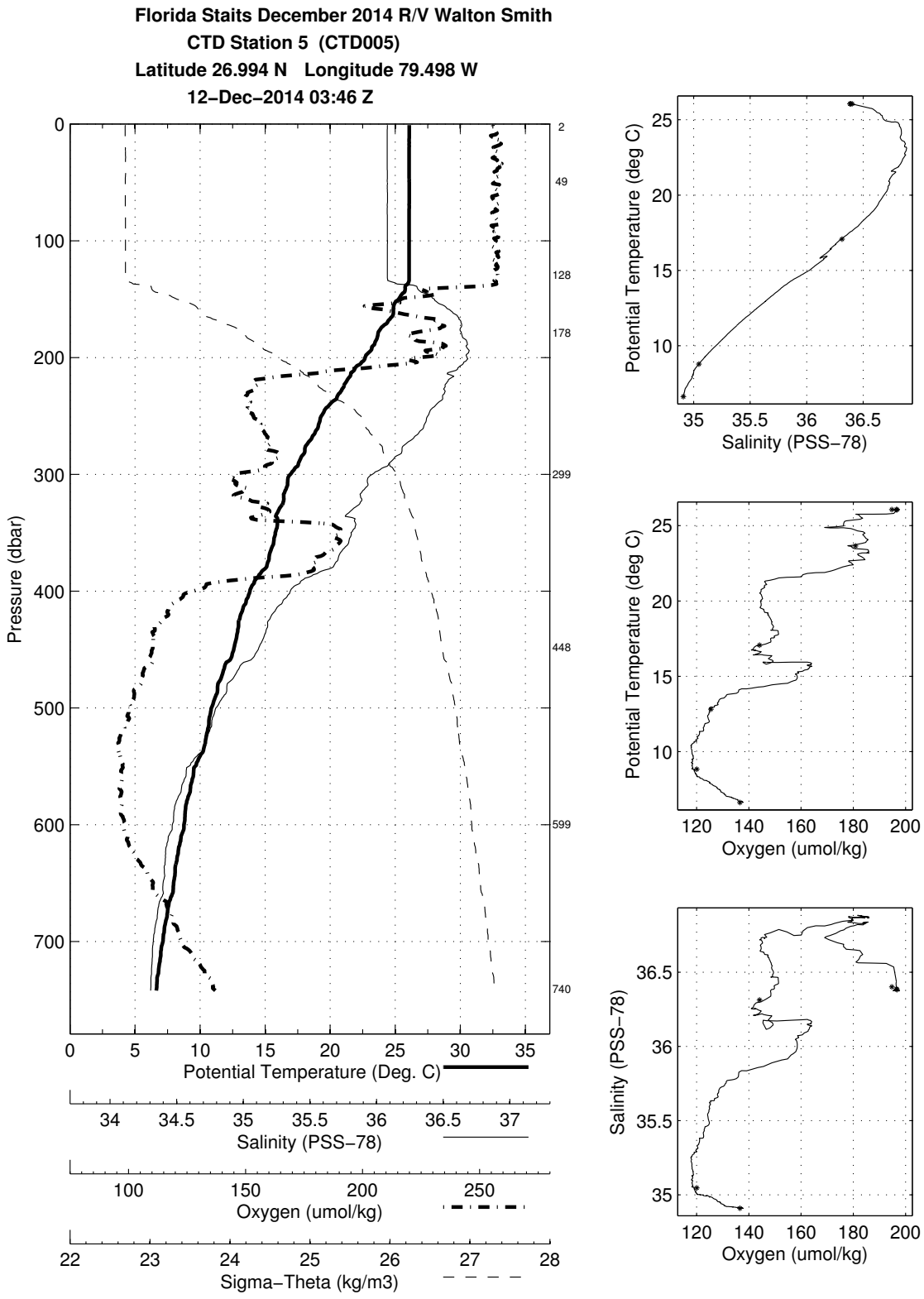
Pressure dbar	Niskin	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}
639	1	6.792	6.732	34.913	135.7
449	2	11.217	11.803	−999.000	NaN
299	3	16.697	16.647	36.226	143.6
179	4	24.296	24.416	−999.000	NaN
129	5	26.187	26.158	36.448	195.4
49	6	26.214	26.203	36.466	196.7
3	7	26.186	26.185	36.466	196.3


Florida Staits December 2014 R/V Walton Smith
CTD Station 4 (CTD004)
Latitude 26.999 N Longitude 79.614 W
12−Dec−2014 05:25 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Oxygen (umol/kg)

Florida Straits 2014 R/V Walton Smith
CTD Station 5 (CTD005)
Latitude 26.994N Longitude 79.498W
12-Dec-2014 03:46Z

Pressure dbar	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}	DynHt m^2·s^{-2}	SigT kg·m^{-3}
1	26.077	26.077	36.378	195.7	0.004	24.049
10	26.076	26.074	36.376	195.3	0.039	24.049
20	26.074	26.070	36.376	195.8	0.077	24.050
30	26.073	26.067	36.376	196.2	0.116	24.051
50	26.086	26.075	36.377	196.1	0.193	24.049
75	26.088	26.071	36.376	196.1	0.290	24.050
100	26.094	26.072	36.378	196.4	0.388	24.051
125	26.097	26.069	36.377	196.1	0.485	24.051
150	25.312	25.279	36.668	176.6	0.579	24.517
200	22.720	22.679	36.871	179.8	0.730	25.446
250	19.362	19.316	36.627	146.0	0.842	26.183
300	16.991	16.941	36.283	142.1	0.931	26.514
400	13.885	13.827	35.775	133.4	1.078	26.823
500	10.925	10.862	35.314	120.5	1.202	27.045
600	8.821	8.755	35.044	119.2	1.308	27.192
700	7.212	7.143	34.926	131.1	1.399	27.341

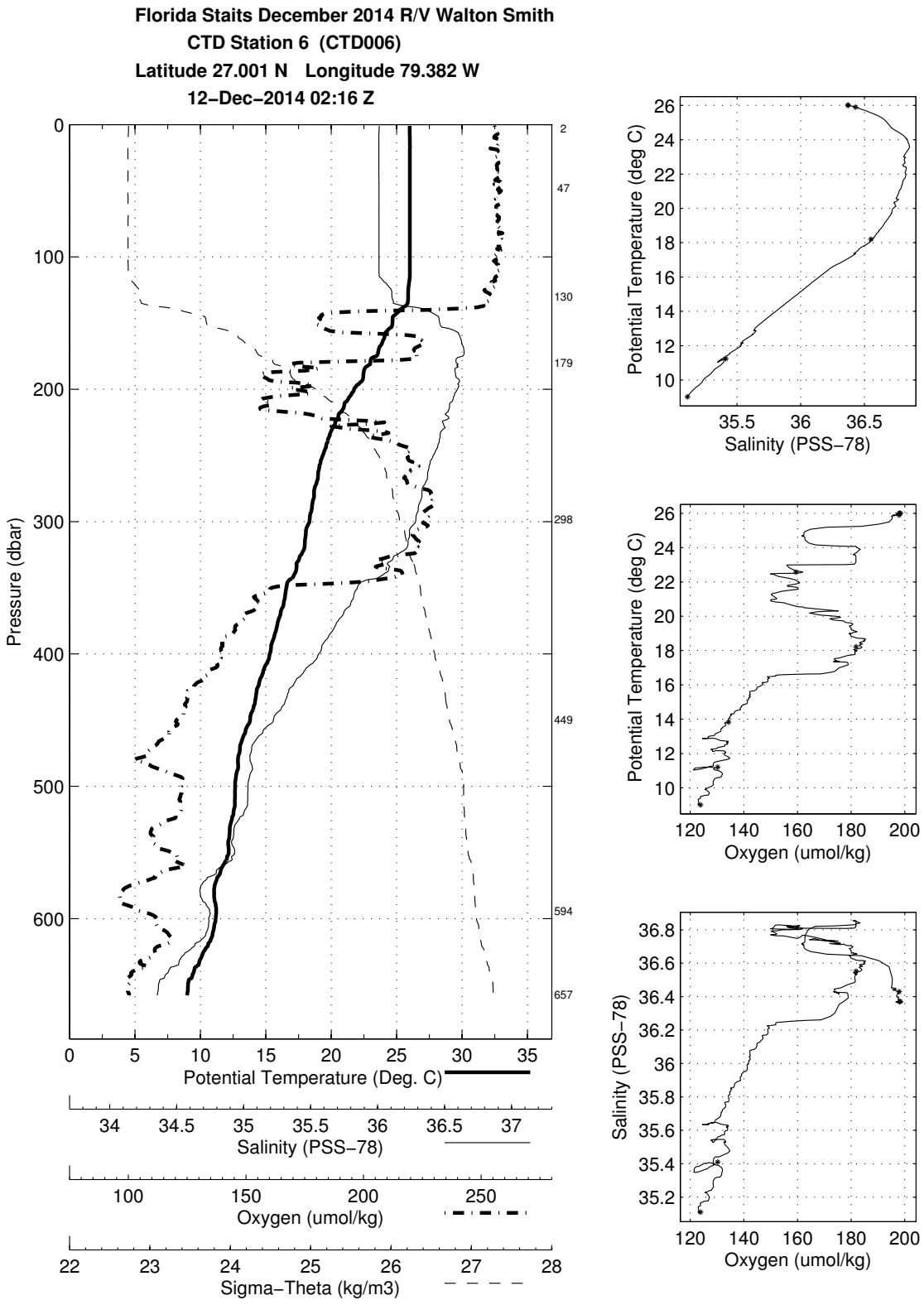
Pressure dbar	Niskin	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}
741	1	6.683	6.612	34.910	136.6
600	2	8.850	8.783	35.047	120.1
448	3	12.839	13.388	−999.000	NaN
300	4	17.127	17.077	36.313	144.1
179	5	23.702	23.827	−999.000	NaN
129	6	26.089	26.060	36.401	194.8
49	7	26.072	26.061	36.388	196.5
3	8	26.065	26.064	36.383	196.7


Florida Staits December 2014 R/V Walton Smith
CTD Station 5 (CTD005)
Latitude 26.994 N Longitude 79.498 W
12−Dec−2014 03:46 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Potential Temperature (deg C)
Oxygen (umol/kg)
Salinity (PSS−78)
Oxygen (umol/kg)

Florida Straits 2014 R/V Walton Smith
CTD Station 6 (CTD006)
Latitude 27.001N Longitude 79.382W
12-Dec-2014 02:16Z

Pressure dbar	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}	DynHt m^2·s^{-2}	SigT kg·m^{-3}
1	26.002	26.002	36.371	197.5	0.004	24.067
10	26.011	26.008	36.368	197.5	0.038	24.063
20	26.017	26.013	36.368	198.2	0.077	24.062
30	26.019	26.012	36.369	198.0	0.115	24.063
50	26.024	26.013	36.369	198.9	0.193	24.062
75	26.027	26.011	36.369	198.2	0.289	24.063
100	26.033	26.011	36.369	198.1	0.386	24.063
125	25.916	25.888	36.439	195.5	0.483	24.155
150	24.711	24.679	36.716	162.1	0.573	24.736
200	21.779	21.739	36.816	156.5	0.713	25.672
250	19.392	19.346	36.679	179.8	0.818	26.215
300	18.384	18.331	36.578	183.3	0.908	26.399
400	15.357	15.295	36.025	142.4	1.067	26.697
500	12.721	12.652	35.621	134.0	1.201	26.944
600	11.238	11.162	35.397	129.1	1.322	27.056

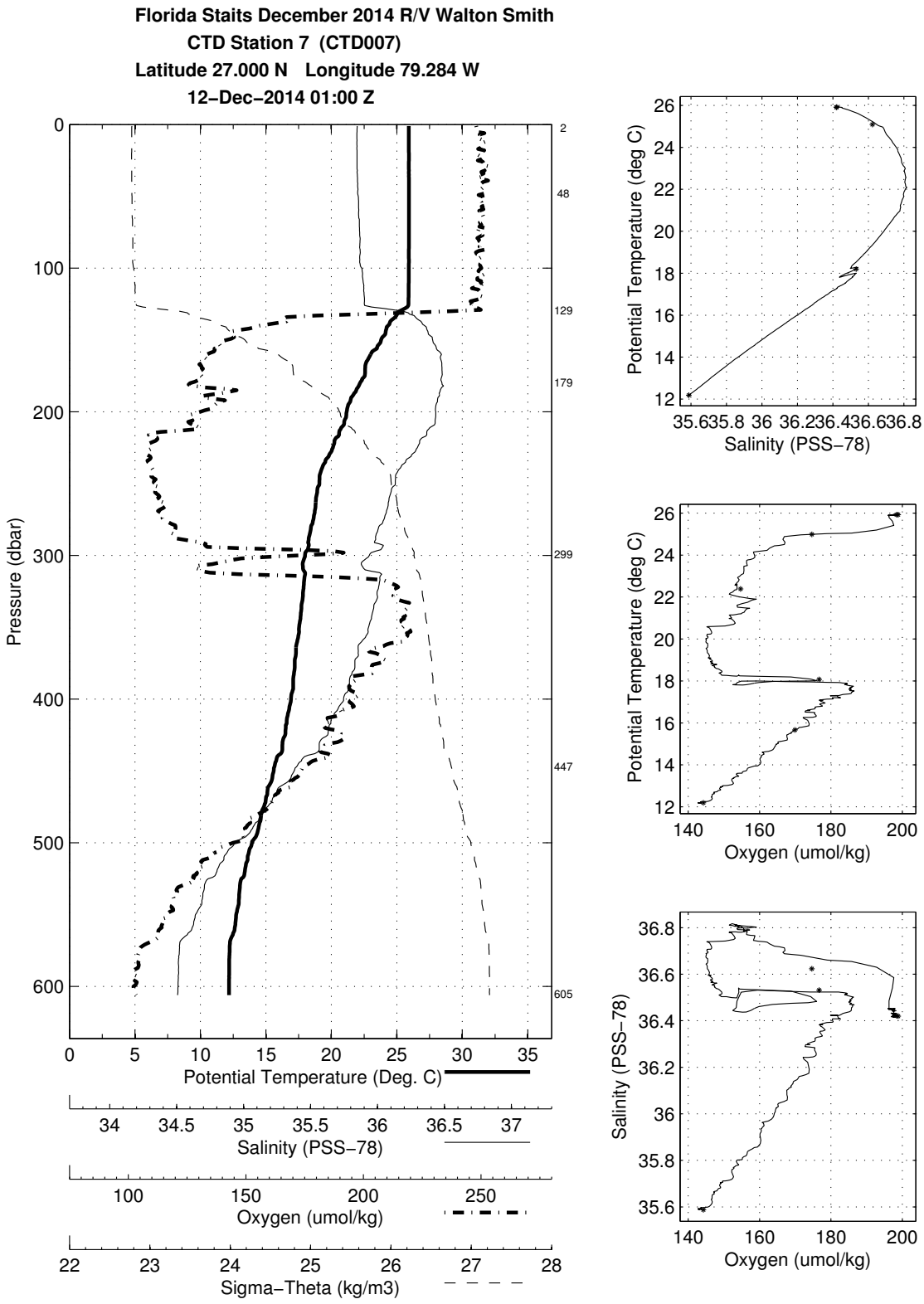
Pressure dbar	Niskin	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}
658	1	9.087	9.013	35.110	123.8
594	2	11.318	11.242	35.411	130.3
450	3	13.909	14.436	−999.000	NaN
299	4	18.251	18.199	36.552	181.8
180	5	22.747	22.881	−999.000	NaN
130	6	25.925	25.896	36.429	197.9
48	7	26.025	26.014	36.370	198.0
3	8	26.005	26.005	36.372	198.2


Florida Staits December 2014 R/V Walton Smith
CTD Station 6 (CTD006)
Latitude 27.001 N Longitude 79.382 W
12−Dec−2014 02:16 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Potential Temperature (deg C)
Oxygen (umol/kg)
Salinity (PSS−78)
Oxygen (umol/kg)

Florida Straits 2014 R/V Walton Smith
CTD Station 7 (CTD007)
Latitude 27.000N Longitude 79.284W
12-Dec-2014 01:00Z

Pressure dbar	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}	DynHt m^2·s^{-2}	SigT kg·m^{-3}
1	25.915	25.915	36.419	196.9	0.004	24.131
10	25.916	25.914	36.417	197.5	0.038	24.130
20	25.923	25.919	36.418	197.7	0.076	24.129
30	25.921	25.915	36.418	198.2	0.114	24.130
50	25.934	25.923	36.424	197.9	0.189	24.132
75	25.937	25.920	36.430	197.1	0.284	24.138
100	25.937	25.914	36.439	197.7	0.380	24.146
125	25.911	25.883	36.452	196.1	0.475	24.166
150	23.822	23.790	36.767	157.4	0.557	25.042
200	21.207	21.168	36.782	153.4	0.685	25.805
250	19.124	19.079	36.595	146.3	0.787	26.220
300	18.040	17.988	36.475	168.7	0.878	26.405
400	16.984	16.917	36.356	177.6	1.043	26.575
500	14.014	13.940	35.855	158.5	1.191	26.861
600	12.266	12.185	35.590	142.8	1.315	27.012

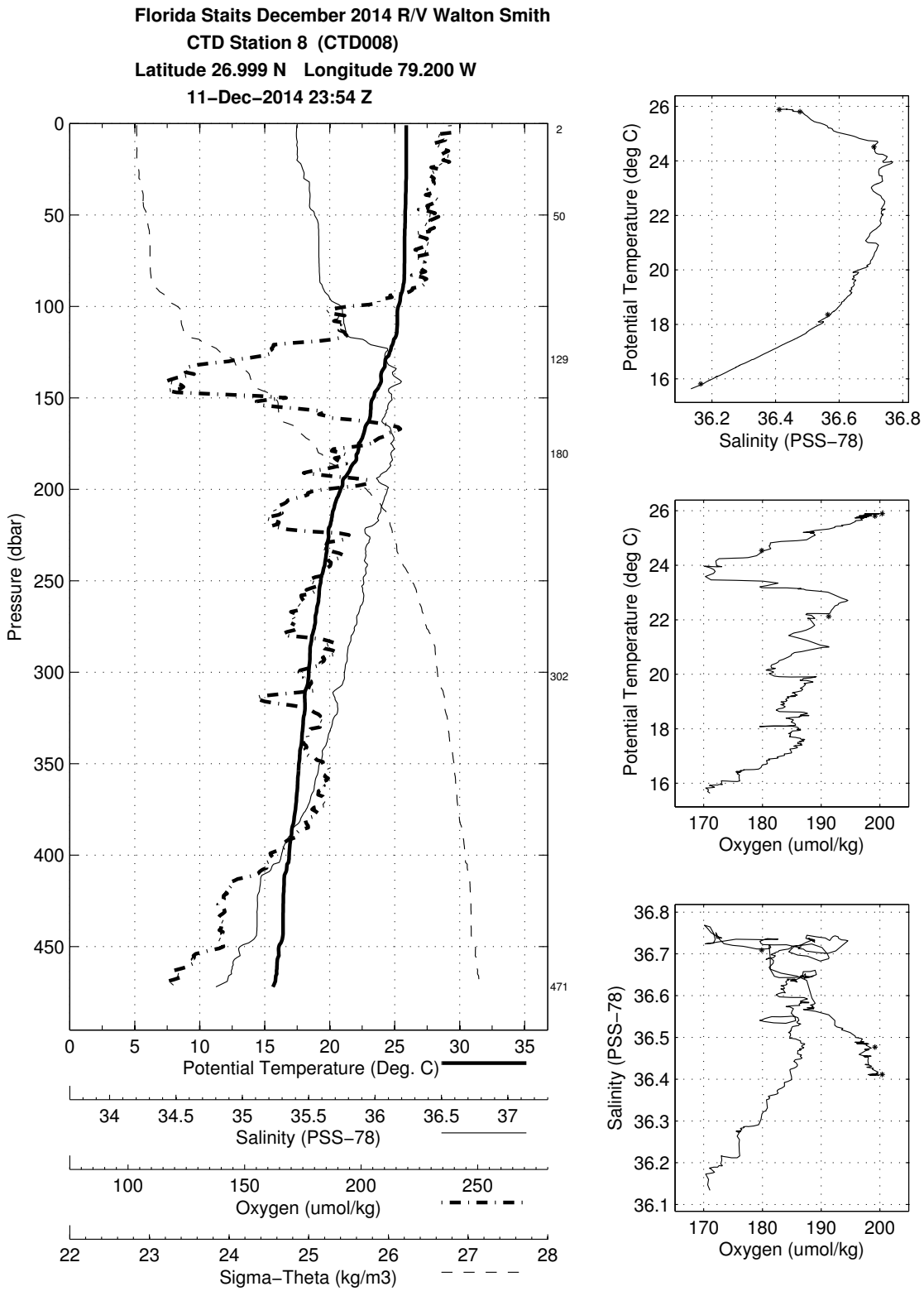
Pressure dbar	Niskin	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}
605	1	12.263	12.181	35.588	144.3
447	2	15.761	16.244	−999.000	NaN
299	3	18.254	18.201	36.531	176.7
180	4	22.354	22.492	−999.000	NaN
130	5	25.117	25.088	36.623	174.6
48	6	25.926	25.915	36.422	198.4
3	7	25.912	25.912	36.419	198.8


Florida Staits December 2014 R/V Walton Smith
CTD Station 7 (CTD007)
Latitude 27.000 N Longitude 79.284 W
12−Dec−2014 01:00 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Potential Temperature (deg C)
Oxygen (umol/kg)
Salinity (PSS−78)
Oxygen (umol/kg)

Florida Straits 2014 R/V Walton Smith
CTD Station 8 (CTD008)
Latitude 26.999N Longitude 79.200W
11-Dec-2014 23:54Z

Pressure dbar	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}	DynHt m^2·s^{-2}	SigT kg·m^{-3}
1	25.891	25.891	36.411	199.7	0.004	24.132
10	25.894	25.892	36.412	198.6	0.038	24.133
20	25.888	25.884	36.411	199.0	0.076	24.135
30	25.901	25.894	36.434	198.1	0.113	24.149
50	25.821	25.810	36.471	197.4	0.188	24.203
75	25.772	25.755	36.486	197.2	0.281	24.232
100	25.302	25.280	36.563	189.0	0.373	24.437
125	24.639	24.611	36.715	181.4	0.459	24.756
150	23.379	23.348	36.735	182.7	0.535	25.149
200	20.870	20.832	36.720	186.6	0.664	25.850
250	19.359	19.313	36.639	185.1	0.767	26.193
300	18.442	18.389	36.574	184.0	0.858	26.380
400	16.948	16.882	36.358	181.1	1.024	26.586

Pressure dbar	Niskin	Temp90 °C	PoTemp90 °C	Salinity PSS-78	Oxygen μmol·kg^{-1}
472	1	15.889	15.813	36.165	NaN
302	2	18.415	18.362	36.564	NaN
181	3	22.104	22.245	−999.000	NaN
129	4	24.544	24.516	36.709	179.9
51	5	25.819	25.807	36.477	199.2
3	6	25.883	25.882	36.411	200.4


Florida Staits December 2014 R/V Walton Smith
CTD Station 8 (CTD008)
Latitude 26.999 N Longitude 79.200 W
11−Dec−2014 23:54 Z
Pressure (dbar)
Potential Temperature (Deg. C)
Salinity (PSS−78)
Oxygen (umol/kg)
Sigma−Theta (kg/m3)
Potential Temperature (deg C)
Salinity (PSS−78)
Potential Temperature (deg C)
Oxygen (umol/kg)
Salinity (PSS−78)
Oxygen (umol/kg)