Joint Analysis Group (JAG)

Review of Preliminary Data to Examine Oxygen Levels In the Vicinity of MC252#1

May 8 to August 9, 2010

Background

This report by the National Incident Command Joint Analysis Group (JAG) presents preliminary data on dissolved oxygen from 419 stations collected by the NOAA Ship *Gordon Gunter*, NOAA Ship *Henry Bigelow*, NOAA Ship *Nancy Foster*, NOAA Ship *Thomas Jefferson*, R/V *Brooks McCall*, R/V *Ferrel*, R/V *Jack Fitz*, R/V *Ocean Veritas*, and R/V *Walton Smith* near the site of the BP Deepwater Horizon (DWH) incident located in the Mississippi Canyon Lease Block area 252 (MC252) and the BP#1 wellhead (MC252#1). The data were collected from May 8 to August 9, 2010. Table 1 shows vessel and cruise dates from which data were analyzed, with notes on data processing issues. Maps 1and 2 show the monitoring area and station locations by date. The results from these measurements were examined by the JAG as a continuation of analyses and data presented in its first two reports.[1]

The Mississippi Canyon Block 252 well #1 released oil and gas for 87 days until the well was successfully capped on July 15. The National Incident Command Flow Rate Technical Group estimated that 4.93 million barrels[2] of oil $\pm$10% were released from the well. Containment actions captured approximately 800,000 barrels of oil prior to the well being capped. Between April 30 and July 15, approximately 771,000[3] gallons of chemical dispersant were added to the oil and gas flow at the wellhead. Of the total oil spilled, approximately 1.2 million barrels were estimated to be naturally or chemically dispersed, the majority of that at the wellhead[4]. Throughout the spill, hydrocarbons and other associated fractions that escaped subsea collection systems at the wellhead, most likely as a mixture of oil, gas, and hydrate[5], resulted in some hydrocarbons reaching the surface and some remaining at depth either dissolved in the water column and or as small droplets.

This report uses available monitoring data to examine whether dissolved oxygen concentrations (hereafter DO_2) were lower than expected at depth that can reasonably be attributed to subsurface dispersed MC252 #1 hydrocarbons, and if so, whether hypoxic conditions or significant reductions in DO_2 concentrations were observed over the period of these measurements. Hypoxia

[1] Joint Analysis Group (JAG) Review of *R/V Brooks McCall* Data to Examine Subsurface Oil. June 2010. http://www.noaa.gov/sciencemissions/PDFs/JAG_Report_1_BrooksMcCall_Final_June20.pdf
Joint Analysis Group (JAG) Review of Preliminary Data to Examine Subsurface Oil In the Vicinity of MC252#1 May 19 to June 19, 2010. http://ecowatch.ncddc.noaa.gov/jag/files/JAG%20Data%20Report%202%20FINAL.pdf

[2] A barrel of oil equals 42 gallons.

[3] http://www.deepwaterhorizonresponse.com/go/doc/2931/853031/

[4] BP Deepwater Horizon Oil Budget: What Happened To the Oil? http://www.noaanews.noaa.gov/stories2010/PDFs/OilBudget_description_%2083final.pdf

[5] Oil in the Sea III: Inputs, Fates, and Effects (2003). p107-108. http://www.nap.edu/catalog.php?record_id=10388.

occurs when the concentration of dissolved oxygen in the water falls to a level that impedes aquatic life. Hypoxic conditions are generally agreed to occur when DO_2 falls below 1.4 mL/L (also expressed as 2 mg/L)[6] though effects levels are species dependent. Hypoxia is regularly observed in the Northern Gulf of Mexico adjacent to the Mississippi River on the Louisiana and Texas continental shelf[7]. Hypoxic conditions do not normally occur in the deep-water layer where MC252 #1 oil has been found. In fact this water layer is relatively rich in DO_2 with a spring climatological mean of 4.8 ± 0.1 mL/L (~6.9 mg/L) at 1500 m depth[8].

Biodegradation of hydrocarbons in the deep water by bacteria is expected to cause consumption of DO_2. The most important factors affecting biodegradation in the environment are weathering of the oil, temperature, dissolved oxygen, and nutrients. The relationship among these factors and hydrocarbon biodegradation are well known[9]. In addition, according to an EPA laboratory study published in 2007, the biodegradation rate of chemically dispersed Prudhoe Bay crude oil at 5 °C was slower than at 20 °C but was still faster than undispersed oil[10]. Dispersant effectiveness (DE) is highly dependent on turbulence (higher turbulence correlates with better DE), temperature (lower temperature correlates with lower DE), and the weight and viscosity of the crude oil (the lower the weight, the more dispersible). High DE resulted in droplet sizes in the range of 2.5 to 60 µm measured in the EPA/Department of Fisheries and Oceans wave tank in Canada using a medium weight crude oil (Prudhoe Bay crude)[11]. This matches the particle size range measured in the 1000-1300 m depth in the Gulf of Mexico at and around the MC252 wellhead. These droplet sizes are consistent with chemical dispersion based on wave tank studies of surface dispersant application. However, the extreme turbulence caused by the high oil velocity emerging from the wellhead together with the light weight of the South Louisiana crude oil (SLC) suggests that dispersion was due to a combination of physical factors and the application of dispersants. The relative importance of these factors remains under investigation.

Oxygen is utilized by bacteria in all major metabolic pathways for hydrocarbon degradation. Biodegradation of 1 L of oil at depth in the Gulf of Mexico consumes the oxygen in 320,000 L of

---

[6] For DO_2, 1 mL/L is approximately equal to 1.43 mg/L
[7] See: http://www.gulfhypoxia.net/Overview/ for more detail on hypoxia in the Gulf of Mexico.
[8] Garcia, H. E., R. A. Locarnini, T. P. Boyer, and J. I. Antonov, 2010. World Ocean Atlas 2009, Volume 3: Dissolved Oxygen, Apparent Oxygen Utilization, and Oxygen Saturation. S. Levitus, Ed. NOAA Atlas NESDIS 70, U.S. Government Printing Office, Washington, D.C., 344 pp.
[9] Atlas, R.M. (1981) Microbial degradation of petroleum hydrocarbons: An environmental perspective. Microbiol. Rev. 45, 180-209.
[10] Venosa, A.D. and E.L. Holder. 2007. "Biodegradability of dispersed crude oil at two different temperatures." Marine Poll. Bulletin 54: 545-553. This experiment was done with a mesophilic oil degrading culture not adapted to cold temperatures. In environments where a psychrophilic (cold-loving) microbial community has evolved, biodegradation can occur at significant rates under cold conditions.
[11] Li, Z., K. Lee, T. King, M.C. Boufadel, and A.D. Venosa. 2009. "Evaluating oil spill chemical dispersion efficacy in an experimental wave tank: 2. Significant factors determining in-situ oil droplet size distributions." Environmental Eng. Sci., 26:1407-1418.

seawater[12]. Oxygen levels below 1.4 mL/L or (2 mg/L) are considered hypoxic by oceanographers and ecologists. Therefore, the DWH Unified Incident Command (UIC) issued a directive establishing DO_2 as one of the major tracking variables in its monitoring plan[13]. The Directive stated that if the DO_2 fell below 2 mg/L (1.4 mL/L) in the deep sea, the UIC would consider discontinuance of dispersant injection. Based on the evidence gathered to date from all available cruise data, the levels of DO_2 have not been low enough to have triggered this shutdown criterion.

Other important variables that have yet to be measured to our knowledge in the deep sea during this spill, but are necessary to determine whether biodegradation may or may not be occurring are dissolved carbon dioxide (dissolved inorganic carbon), dissolved nitrogen (ammonium, nitrite, nitrate, and/or total Kjeldahl nitrogen), dissolved inorganic phosphorus (phosphate), and the concentrations of hydrocarbon degrading bacteria.

Measurement of Dissolved Oxygen

DO_2 in the deep ocean can be measured with electronic and chemical methods that vary in their precision and accuracy. These variations may encompass potential for interference from organic materials and oxidizing and reducing agents possibly present near the MC252 site. The Sea-Bird Electronics, Inc. SBE 43 *in situ* sensor uses a Clark polarographic type membrane for measuring DO_2. The SBE 43 captures readings at 2-second intervals as it is lowered and raised through the water column. The large majority of the DO_2 data used in this report are vertical profiles from this sensor attached to a Conductivity, Temperature at Depth (CTD) sensor. *In situ* sensors are calibrated at the factory but additional field calibration to account for drift over time, systematic offsets, and to validate the measurements are necessary. Besides calibration, these sensor systems are subject to a number of known issues that can affect data quality, including data transmission problems associated with the thousands of meters of conducting wire and related electrical connections, and can experience interference from contaminants in the sampled water. In addition, instrument setup, deployment, and post processing software setting must be appropriate and consistent. An extreme case can be seen in Figure 1, showing a problem likely associated with an electrical connection to the CTD.

DO_2 was also measured in discrete water samples collected at specific depths using Niskin sample bottles during multiple cruises. The DO_2 in these samples can be tested using chemical or electronic methods implemented in a variety of ways, including commercial kits such as the LaMotte and Hach brand DO_2 field test kits. These kits are adaptations of the classic Winkler chemical titration method and are considered easier but are significantly less precise and accurate than the original Winkler procedure. Automated Winkler chemical titration techniques using

[12] Atlas, 1981. R.M. Atlas, Microbial degradation of petroleum hydrocarbons: an environmental perspective. *Microbial. Rev.* **45** (1981), pp. 180–209.
[13] http://www.epa.gov/bpspill/dispersants.html#directives

photometric or amperometric end-detection methods are generally considered by oceanographers to be the most accurate method with the highest precision for measuring DO_2 at sea when they are performed by a trained operator with carefully prepared reagents and standards and calibrated flasks following accepted protocols (*e.g.*, World Ocean Circulation Experiment [WOCE], Climate Variability and Predictability [CLIVAR]). These methods can be affected by sampling errors, reagent quality, operator inconsistencies, and interference from contaminants in sampled water. On some monitoring cruises, additional DO_2 measurements from bottle samples on deck were made at times with an Extech membrane-based DO_2 probe, a YSI ProODO (optical probe), and a YSI Ecosense 200 (membrane probe). Regardless of the analytical method, measuring DO_2 in bottle samples is also complicated by the need to prevent sample contamination by atmospheric oxygen during oxygen measurement.

Data Analysis and Interpretation

CTD DO_2 continuous profiles collected during some cruises show significant offsets as a function of depth or density relative to DO_2 profiles from other research cruises. In addition, agreement was initially poor among different *in situ* measurements and discrete water bottle samples (Appendix 3) for the R/V *Brooks McCall*. The agreement significantly improved in later cruises as experience was gained and more precise methods were consistently used (Appendix 4). However, all of the DO_2 data presented here have received preliminary data quality control (QC) and quality assurance (QA) controls. Methods for data QC, QA, and processing for analysis are contained in Appendix 4.

To help examine the spatial and temporal evolution of the CTD DO_2 anomalies, it is important that the DO_2 profiles from the different cruises are compared and systematically assessed to help derive an internally consistent DO_2 data product. This process generally involves quantifying and correcting for systematic biases in the reported DO_2 profiles relative to a chosen reference. The NOAA Ship *Nancy Foster*, R/V *Brooks McCall*, and R/V *Ocean Veritas* conducted amperometric Winkler titrations during cruises conducted in August. However, only some of those reference data were available at the time of this report. Absent those data, the JAG considered using as a preliminary reference the World Ocean Atlas 2009 (WOA09) objectively analyzed 1-degree DO_2 annual mean climatology at standard depth levels because they provide a well documented and representative comparative data set. The WOA09 annual O_2 climatology is derived from quality-controlled historical Winkler O_2 measurements, regardless of year of observation, from the World Ocean Database 2009 (WOD09[14]) (Figures 2-4). As an exploratory first step, CTD DO_2 profiles from each cruise were adjusted to match the WOA09 reference profile over the depth range from 500 to 800 m. This depth range was preliminarily chosen

[14] Boyer, T.P., J. I. Antonov , O. K. Baranova, H. E. Garcia, D. R. Johnson, R. A. Locarnini, A. V. Mishonov, T. D. O'Brien, D. Seidov, I. V. Smolyar, M. M. Zweng, 2009. World Ocean Database 2009. S. Levitus, Ed., NOAA Atlas NESDIS 66, U.S. Gov. Printing Office, Wash., D.C., 216 pp., DVDs.

because it is below the surface layer where DO_2 gradients are strong and variable and above the depths where anomalous DO_2 depressions are nominally observed. Slope and offset parameters were derived by means of linear least-squares. This method is very sensitive to differences in the slope of the CTD vs. reference-profile regression over the analysis interval (500-800 m), and as a result it was not possible to apply this method to the whole data set due to cruise-to-cruise non-systematic variations in CTD DO_2 profiles as shown in Figure 5. These data warrant evaluation in the future using alternate approaches to allow inter-comparisons. We assume that systematic biases are primarily instrumental. According to Sea Bird, Inc., "Normal calibration drift manifests itself as a loss of sensitivity and is evident as a change of slope (and less so in offset) in the linear relationship between oxygen concentration and voltage output."[15]

Because inter-cruise instrument offsets could not be corrected, within-cruise DO_2 profiles were used as one means of examining the relative level and trend in DO_2 depressions. The total of all profiles considered in this report as compared to the annual mean climatology are shown in Figure 6. Examining WOD09 historical *in situ* DO_2 measurement made clear that we could also assume that short-term DO_2 variability among casts on a particular cruise below 1000 m depth is relatively small when compared to the magnitude of the DO_2 anomalies (see, for example, Figures 7 and 8). Winkler chemical titrations amperometric end-detection methods were available for comparison to SBE 43 measurements for data collected August 1-2 on the R/V *Ocean Veritas* and August 4-6 on the R/V *Brooks McCall.* Those data are shown in comparison with WOA09 data in Figures 9 and 10.

Conceptual Model

It is useful to consider a conceptual model for how monitored variables such as DO_2 would change during the course of a prolonged oil spill. Early in the event, when bacterial biomass was low, hydrocarbons would be found without an associated depression in DO_2 resulting in significant CDOM fluorescence anomalies but no appreciable DO_2 anomaly. As microbial communities develop, depressions in DO_2 would be correlated in space and time with CDOM fluorometer measurements of oil. As microbial degradation of hydrocarbons continues, DO_2 depressions will be found even in the absence of measurable fluorescence signals as oil is degraded.

Evidence suggests fluorescence measurements of oil are related to density of the water layer in which the oil is found (Figure 13). This evidence suggests that the oil is staying primarily with the water layer described by a potential density 1027.70-1027.71 kg/m^3 (Sigma Theta values of 27.70 and 27.71, where sigma theta = potential density-1000). A DO_2 drawdown due to hydrocarbon-based BOD would be expected to occur within this same water layer though not in a one-to-one relationship when the conceptual model is considered.

[15] http://www.seabird.com/application_notes/AN64-2.htm

Interpreting spatial and temporal patterns in DO_2 requires knowledge of the advection and diffusion in the water layer where the depression is found as well as DO_2 utilization rates. Measurements of current velocities and direction in the deep-water layer where the oil has been found are available from an Acoustic Doppler Current Profiler (ADCP) very near the wellhead (station id 42916). During the time period of the investigation, currents are variable but predominantly southward, with stronger flows of 15-20 cm/s to the ESE, SSE and WSW (Figure12). Because currents fluctuate and reverse, water that was transported to the northeast can flow back towards the area around the well. Because of this, distance from the wellhead does not simply correlate with time since release from the wellhead. Higher variability in both DO_2 and oil measurements near the wellhead will be expected because of these variable currents. However, the overall net transport of the deep water is to the southwest of the well. Currents will tend to flow along an isobath. As distance from the well increases, diffusion within the water layer and with adjacent water layers will tend to establish more uniform conditions.

Given this context, summary presentations of the available DO_2 observations have been compiled. The change in DO_2 values over time (mean values in Figure 41 and minimum values in Figure 43) do not reveal obvious trends. Lowest values were observed in late May/early June and mid-July to present, but it is unclear if this is an artifact of the (essentially) random sampling. Conditions have not changed dramatically over time within the area sampled. Consideration of the spatial structure of the DO_2 observations (mean values in Figure 42 and minimum values in Figure 44) indicates little change in the range of DO_2 values with radial distance away from the wellhead. No observations have been less than 2.5 mL/L and thus have remained more than 1 mL/L above hypoxic levels (Figures 43 and 44).

Appendix 2 presents conceptual box model analyses of the impact biodegradation could have on the time required to reach hypoxia in the deep sea. The primary assumption of the model was that DO_2 utilized to biodegrade oil was not replenished from mixing with oxygen-rich surrounding water. Several scenarios are presented in Appendix 2 to define the upper and lower boundaries that delineate the minimum and maximum times (24 ± 5 d to 74 ± 2 d), respectively, needed for hypoxia. Results from the theoretical scenarios indicate the primary assumption, namely that mixing did not occur, was incorrect since hypoxia, which would have already occurred under these scenarios, has not been observed. Appendix 2 also compares conceptual model results with biodegradation results of the 2007 EPA laboratory study and the recent Lawrence-Berkeley study. Rates of biodegradation in the latter studies were much faster than the hypothetical scenarios, which supports the notion that mixing must have occurred in order to meet the observed DO_2 concentrations reported throughout this paper.

Conclusions to date

The dissolved oxygen measurements showing anomalies around 1000 m and extending to 1300-1400 m (identified in previous JAG reports) are interpreted as actual low values consistent with the depths of occurrence of the MC252 #1 hydrocarbons. These depressions range from approximately 0.1 mL/L to 2.6 mL/L. The conclusions in this report are relevant for the deep-water layer in which MC252 #1 oil has been found using the data available to the JAG through August 9 (Appendix 6). Figures 14 –40 show data for each cruise used to make this report's conclusions. The SBE 43 data are plotted against water density (left hand scale) and using colors to identify the corresponding depth as shown on the right hand scale. Sample station locations included in the plot are shown relative to the wellhead on the map insert. Figures 41 and 42 show mean DO_2 values changing over space and time with reference to the mean and standard deviation for the 1-degree ocean climatology. Figures 43 and 44 show minimum DO_2 values with respect to the generally agreed upon value for hypoxic conditions (1.4 mL/L). Map 3 shows these values in relationship to the wellhead, with the highest values noted. On the basis of all the information presented in this report, the JAG conclusions to date are:

- Significant DO_2 low values (depressions) relative to background concentrations are being measured in the water layer at many stations where MC252 #1 oil has been observed. These depressions have been measured by means of different DO_2 instruments and methods.
- Measurements of the DO_2 depression have not approached hypoxic levels. Hypoxic conditions are not expected to occur in the deep-water layer where MC252 #1 oil has been observed.
- The depth layer of the DO_2 depressions is coincident with fluorescence-based measurements of MC252 oil when a fluorescence anomaly is present.
- The DO_2 depressions are most likely due to biochemical oxygen demand of MC252 hydrocarbons in the deep-water layer.
- The minimum DO_2 levels in this data set were measured using the SBE 43 by the R/V *Walton Smith* on May 27 (station WS15a) about 18 km from the wellhead (2.96 mL/L) and the R/V *Ocean Veritas* on July 28 (station OV144) about 40 km from the wellhead (2.56 mL/L).
- The DO_2 depression has been found more than 80 km from the wellhead based on CTD DO_2 measurements.

- DO_2 depressions do not appear to be increasing over time, suggesting that the rate of hydrocarbon BOD is compensated by mixing with higher DO_2 waters surrounding the DO_2 depleted water layer.

- DO_2 levels should continue to be monitored using polarographic sensors and discrete samples from Niskin bottles using amperometric end-detection Winkler chemical titration methods until the end of August 2010. At that time available DO_2 and other data should be evaluated to determine if any further monitoring in support of response operations is warranted.

- This report does not discuss the broad ecosystem consequences of MC252 #1 hydrocarbons released into the environment.

Members of the Joint Analysis Group appointed to date:

FEDERAL MEMBERSHIP

National Oceanic and Atmospheric Administration

Dr. Steven Murawski, NOAA Fisheries Service, Silver Spring, MD (JAG Lead)

Dr. Robert Pavia, Contractor, NOAA Office of Response and Restoration, Seattle, WA (Deputy Lead)

Russ Beard, National Coastal Data Development Center, Stennis Space Center, MS

Dr. Richard L. Crout, National Data Buoy Center, Stennis Space Center, MS

Dr. Jim Farr, NOAA Office of Response and Restoration, Seattle, WA

Dr. Jerry Galt, Contractor, NOAA Office of Response and Restoration, Seattle, WA

Dr. Hernan Garcia, National Oceanographic Data Center, Ocean Climate Laboratory, Silver Spring, MD

Dr. Jeffrey Napp, Alaska Fisheries Science Center, Seattle, WA

Dr. Rost Parsons, National Coastal Data Development Center, Stennis Space Center, MS

Benjamin Shorr, NOAA Coastal Protection & Restoration Division, Seattle, WA

Dr. Scott Cross, Regional Science Officer, National Coastal Data Development Center, Charleston, SC

Dr. Sam Walker, NOAA IOOS, Silver Spring, MD

Dr. Rik Wanninkhof, Atlantic Oceanographic and Meteorological Laboratory, Miami, FL

U. S. Environmental Protection Agency

Dr. Robyn N. Conmy, US EPA, Ecosystem Dynamics and Effects Branch, National Health and Environmental Effects Research Laboratory, Gulf Breeze, FL

Dr. Jan Kurtz, Office of Research and Development, National Health and Environmental Effects Research Laboratory, Gulf Breeze, FL

Dr. Blake Schaeffer, US EPA, Ecosystem Dynamics and Effects Branch, National Health and Environmental Effects Research Laboratory, Gulf Breeze, FL

Dr. Albert Venosa, US EPA, Land Remediation and Pollution Control Division, National Risk Management Research Laboratory, Office of Research and Development, Cincinnati, OH

Dr. Gregory Wilson, US EPA Office of Emergency Management, Washington, DC

The White House

Dr. Jerry Miller, Office of Science and Technology/Executive Office of the President

Information Coordination and Synthesis Provided by:

Applied Science Associates (ASA)

Lauren Decker, Physical Oceanographer

BP

Mike Staines, BP, Houston, TX
Anne Walls, BP, United Kingdom

Fisheries and Oceans Canada

Dr. Ken Lee, Fisheries and Oceans Canada, Bedford Institute of Oceanography

University of New Hampshire

Dr. Larry Mayer, Center for Coastal and Ocean Mapping, Joint Hydrographic Center
Dr. Tom Weber, Center for Coastal & Ocean Mapping, Joint Hydrographic Center

University of North Carolina

Dr. Harvey E. Seim, Department of Marine Sciences, UNC Chapel Hill

The JAG wishes to acknowledge and thank the scientists and crews of the R/V *Brooks McCall*, R/V *Ferrel*, NOAA Ship *Gordon Gunter*, NOAA Ship *Henry Bigelow*, R/V *Jack Fitz*, NOAA Ship *Nancy Foster*, R/V *Ocean Veritas*, and NOAA Ship *Thomas Jefferson* for their efforts to collect the data that are included in this report. The JAG also acknowledges and thanks Dr. Samantha Joye (University of Georgia) and the scientists and crew on the R/V *Walton Smith* for contributing their CTD and oxygen data for inclusion in JAG analysis and reporting, and encourages other academic and private partners to do so as well. In addition, the JAG thanks the

National Science Foundation for supporting research efforts and encouraging collaboration with the JAG.

Table 1. Information for vessel data collection cruises included in this report with comments on station data quality.

Vessel	***Cruise***	***Cruise Start Date***	***Cruise End Date***	***Number of Stations***	***Number of Casts***	***Processing Comments***
Brooks McCall				167	178	
	Cruise 01	8-May	11-May	18	18	*Stations 1-18, all bad data - no results*
	Cruise 02	15-May	17-May	10	10	*Stations 19-28, all bad data - no results*
	Cruise 03	19-May	21-May	13	13	*Stations 29-41, Cable Issue effected Dissolved Oxygen (SBE43) measurements*
	Cruise 04	23-May	25-May	11	11	*Stations 42-52, Cable Issue effected Dissolved Oxygen (SBE43) measurements*
	Cruise 05	30-May	1-Jun	12	12	*Stations 53-64, all processed without error*
	Cruise 06	5-Jun	7-Jun	10	10	*Stations 65-74, station 71 bad data, all others processed without error*
	Cruise 07	11-Jun	13-Jun	13	13	*Stations 75-87, all processed without error*
	Cruise 08	17-Jun	19-Jun	12	14	*Stations 88-99, stations 90 and 96 done twice. Stations 90a had problems processing the bottle data, stations 91, 92, 93 have no configuration file with which to process; stations 94 and 95 would only process on downcast only; station 96a had only two values*
	Cruise 09	23-Jun	26-Jun	12	12	*Stations 100-111. Station 101 had problems with the bottle data, all others processed without error.*
	Cruise 11	5-Jul	7-Jul	6	6	*Stations 112-117. Station 114 had a .hex file with 0 bytes. Station 112 had problems processing the bottle data.*

	Cruise 12	11-Jul	13-Jul	12	15	*Stations 118-130. Station 129 was done three times and station 130 was done twice. Station 126 has the data from a station numbered 128; and a station 128 was not submitted. Comments in the folder for Station 128 noted the name mixup. Station 129 did not process for bottle data. Stations 129a and 129b did not process. Station 130 had no bottle data, but 130a did process fully. Noted increase QC flags set for salinity profiles on later casts.*
	Cruise 13	17-Jul	19-Jul	10	16	*Stations 131-140. Stations 132, 133, and 135 were done twice. Station 134 was done three times (134, 134A, 134B) and station 136 was done twice, although they were named 136C and 136D. Station 134 will not process and provides no error message. There was no bottle data processed for stations 132, 133, 135, and 136C. CTD problem detected on early casts through salinity and density checks (constant signal at deep depths).*
	Cruise 15	29-Jul	31-Jul	13	13	*Stations 141-153, all processed without error.*
	Cruise 16	4-Aug	7-Aug	15	15	*Stations 154-168, all processed without error*
Ferrel				13	15	
	Cruise 02	16-Jul	19-Jul	4	5	*Stations 1-4, Station 3 was done twice (3 and 3a). Station 3 was not able to process for bottle data. Station 3a would not provide an ASCII output.*
	Cruise 03	26-Jul	29-Jul	6	6	*Stations 2, 6-10. Stations 7 and 8 are reversed, but we left as is because the maps identify Stations 7 and 8 and we didn't know which was which. Station 2 and 8(or 07?) did not have bottle data to process.*

	Cruise 04	31-Jul	4-Aug	3	4	*Stations 1-3. Station 1 was done twice (1 and 1a). Station 1 did not process for bottle data.*
Gordon Gunter				40	40	
	Cruise 01	28-May	4-Jun	30	30	*Stations 001-H through 030-H. Stations 016-H, 018-H, 021-H, 022-H, 024-H, and 026-H did not process for bottle data.*
	Cruise 03	5-Aug	7-Aug	10	10	*Stations 1-10. All stations processed without error.*
Henry Bigelow				30	33	
	Cruise 01	3-Aug	5-Aug	30	33	*Stations 1-30. Stations 1, 2a, 5, 8, 12, 13, and 28a did not process for bottle data, Stations 2b and 28c did not produce an ASCII output.*
Jack Fitz				28	37	
	Cruise 01	10-May	13-May	5	5	*Stations 1-5, no bottle data on any stations.*
	Cruise 02	22-May	31-May	11	17	*Stations 1-11. Station 6 does not have a .con file. No bottle data for any stations.*
	Cruise 03	12-Jun	20-Jun	12	15	*Stations 1-12. Processed on downcast only. No bottle data for any stations.*
Nancy Foster				73	73	
	Cruise 01	1-Jul	18-Jul	73	73	*Stations 1-75, except 28 and 29. All stations processed without error except 18, which did not process for bottle data and 35, which had 0 values in post-processed results. Fluorescence values were all recorded in voltage for both Fluorescence sensors used, so data could not be used for analysis.*
Ocean Veritas				156	156	
	Cruise 01	27-May	29-May	12	12	*Stations 1-12. Stations 6-8 did not process for bottle data. Cable and or connector issue contaminate most of the profile data with spikes.*

	Cruise 02	2-Jun	4-Jun	13	13	*Stations 13-26, except 14. Station 13 had no .con file, Stations 15 and 16 did not process for bottle data, Stations 17-20 had no .con file. Cable and or connector issue contaminate most of the profile data with spikes.*
	Cruise 03	8-Jun	10-Jun	14	14	*Stations 27-40. Cable and or connector issue contaminate most of the profile data with spikes.*
	Cruise 04	14-Jun	16-Jun	15	15	*Stations 41-55. Station 41 did not process. All others processed without error*
	Cruise 05	20-Jun	20-Jun	7	7	*Stations 56-62. Station 62 is the only station that processed.*
	Cruise 06	26-Jun	28-Jun	13	13	*Stations 63-75. Stations 70 and 75 did not process for bottle data.*
	Cruise 07	2-Jul	4-Jul	15	15	*Stations 76-90. All stations processed without error.*
	Cruise 08	8-Jul	10-Jul	15	15	*Stations 91-105. All stations processed without error.*
	Cruise 09	14-Jul	16-Jul	17	17	*Stations 106-122. Stations 116, 121, and 122 did not process for bottle data.*
	Cruise 10	20-Jul	22-Jul	15	15	*Stations 123-137. Stations 128-132 had no .con/.hex files available.*
	Cruise 11	27-Jul	28-Jul	11	11	*Stations 138-148. All stations processed without error.*
	Cruise 12	1-Aug	2-Aug	9	9	*Stations 149-157.*
Thomas Jefferson				71	72	
	Cruise 02	3-Jun	7-Jun	14	14	*Stations 1-15, except 13. All stations processed without error.*
	Cruise 03	8-Jun	26-Jun	57	58	*Stations 16-72. Station 69 was processed twice.*
Walton Smith				79	92	

Cruise 01	26-May	31-May	51	57	*Stations WS01A- WS51A. Stations WS04A-11A, WS24A-25A, WS28A-29A, WS44A, WS49A did not process for bottle data.*
Cruise 02	3-Jun	5-Jun	28	35	*Stations WS52A-79A with some random numbers included (i.e. WS06B, 08B, 16B, 47B, 53B, 58B, 59B, 68B, 71B, 71C) Station 71A did not process. Stations 54A, 58A, 61A-66A, 59B, 68B, 69A-72A did not process for bottle data. Station numbers 65 and 74 were skipped.*

Appendix 1

Biodegradation rates of Deep MC252 Plume

ERNEST ORLANDO LAWRENCE BERKELEY NATIONAL LABORATORY

Center for Environmental Biotechnology
July 30, 2010

To: Mark Miller, Robert Jones, Nathalie Valette-Silver, and Al Venosa

RE: Biodegradation rates of Deep MC252 Plume (per pre-publication Embargo waiver)

To estimate biodegradation rates in the plume, four data sets representing concentrations of C13-C26 n-alkanes were used to investigate degradation of hydrocarbons in the plume. Two of the data sets were field measurements from sites included in this paper: BM57, BM58, BM53, BM54, OV011, OV010. N-alkanes were not detected in any or the other field samples. The first data set was provided by BP and included analysis of a wide number of compounds from whole water samples, including n-alkanes. This data set is inclusive of all samples with the exception of OV011. The second data set are n-alkanes quantified from the neutral lipid fraction of the PLFA analysis and represents samples collected on a 0.2 μm PES filter. Both of these data sets were taken from the same CTD deployment but analyzed by different labs.

The other two data sets represent 5°C laboratory degradation studies of degradation of source oil in microcosm water collected outside the plume with MC252 oil as the carbon source and isolates from the plume mixed as a consortia with MC252 oil. Microcosms were set up using non-contaminated water from plume depth (OV02302) sampled June 6th 2010. 100 ml of the water was placed in 125 ml serum bottles and crude oil (MC252) was added to obtain a concentration of 100 mg/L. Bottles were closed using Teflon coated rubber stoppers and were incubated at 5°C in the dark for 20 days. Samples for analysis of hydrocarbons were taken after 0, 1, 5, and 20 days of incubation. Oil Degradation in Consortia: 2 ml of oil plume depth water was enriched in 18 ml bicarb buffered minimal marine medium (Coates et al 1995) amended with 0.05 g bactopeptone and 500 μL MC252 oil. From this enrichment, after four weeks, a transfer was made into fresh minimal marine media with no Carbon source. After incubation for 48 h, this was used as the inoculum for the oil degradation experiment. The experiment was initiated in 45 ml minimal marine medium with 1000 mg/L MC252 oil as the sole carbon source in triplicates at 5°C. Heat killed controls were set up in parallel to account for abiotic loss of oil hydrocarbons. Samples were withdrawn for GC-MS analyses using sterile syringes after well mixing after 0, 2, 5, and 8 days.

Degradation rate coefficients and half life (Table XX1, XX2) were calculated from the alkane data from these four sources using the 1st order rate equation(MacNaughton et al., 1999; Venosa and Holder, 2007). For field experiments, BM53, BM54, and OV011 were considered a day 0 sampling point, and BM57, OV010 were considered intermediate points (either 1 or 3 days) and BM58 was considered the final point (either 2 or 5 days), using estimated travel times of 2 – 5 days between the day 0 and final sampling points. This range is the best estimate given recorded ocean currents

Lawrence Berkeley National Laboratory, One Cyclotron Road, MS 70A-3317, Berkeley, CA 94720
Tel: 510-486-6223; Fax: 510-486-7152; E-mail: tchazen@lbl.gov

(http://www.ndbc.noaa.gov/station_page.php?station=42916&unit=M&tz=STN, Hamilton, 1990).

These rate constants are similar to those reported in the literature for similar temperature and field conditions (MacNaughton et al., 1999; Brakstad and Bonaunet, 2006; Venosa and Holder, 2007; Atlas and Bragg, 2009) and despite the varying conditions only vary by a factor of 5 and represent half lives of 1.2 - 6.1 days. Given the similarity of the rate of disappearance of alkanes in the plume to the rates observed in the laboratory, it is likely that the actual degradation of alkanes lies within this range and it is also likely that the disappearance of alkanes is due in large part to biodegradation. For each data set, decay constants are similar for all alkanes measured in all samples, with the exception of the plume samples from the NL fraction collected on 0.2 μm filters. Since these results represent extraction from free phase oil or oil sorbed to the PES membrane filter, it is likely the higher rates seen for the shorter chain alkanes is due to additional losses in collected sample due to dissolution into sea water. However, there is a correlation of longer chain alkane concentration with cell densities (see figure XX1) in the plume.

Lawrence Berkeley National Laboratory, One Cyclotron Road, MS 70A-3317, Berkeley, CA 94720
Tel: 510-486-6223; Fax: 510-486-7152; E-mail: tchazen@lbl.gov

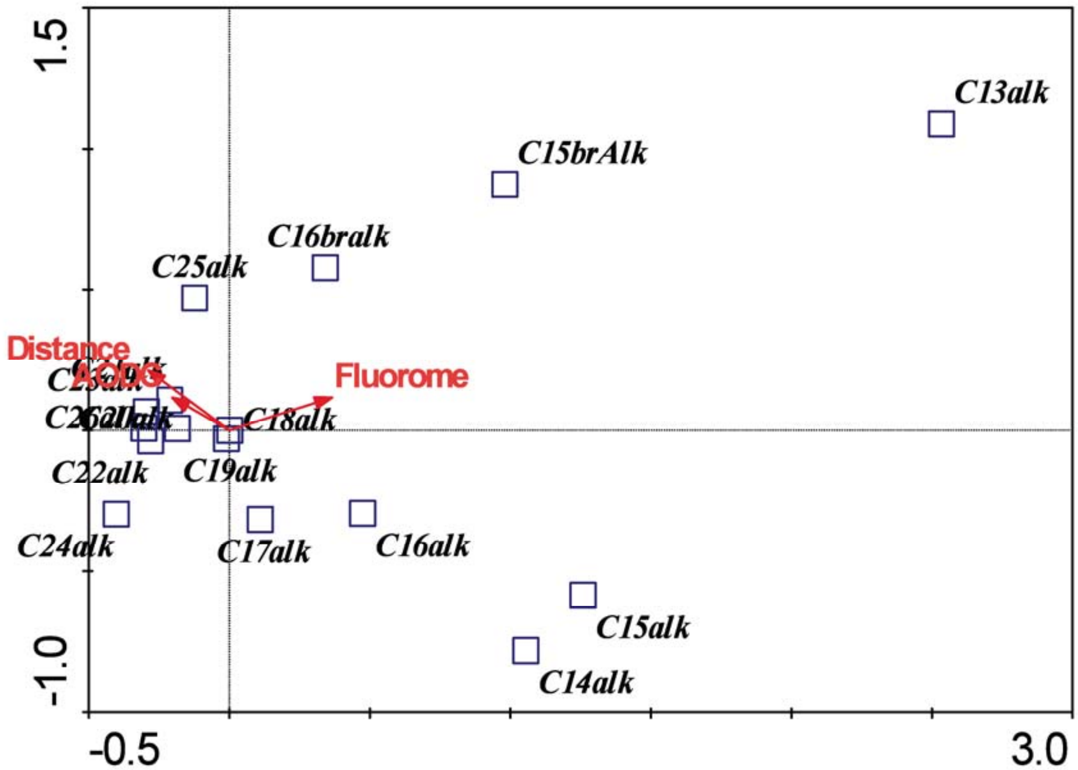
Table XX1. MC-252 crude oil alkane first order decay constants ($days^{-1}$) from field and laboratory

		plume samples (2 d)	plume samples (5 d)	BP data (2 d)	BP data (5 d)	Mixed Consortia, 5°C	Micro-cosm water, 5°C
	Average	**0.319**	**0.128**	**0.643**	**0.257**	**0.197**	**0.313**
n-Tridecane	C13alk	0.438	0.175	0.497	0.199	0.227	0.324
n-Tetradecane	C14alk	0.460	0.184	0.506	0.202	0.197	0.304
Pentadecane	C15alk	0.458	0.183	0.709	0.284	0.193	0.329
n-hexadecane	C16alk	0.432	0.173	0.344	0.138	0.193	0.310
n-heptadecane	C17alk	0.399	0.160	0.615	0.246	0.190	0.298
Pristane	C19teralk	0.427	0.171	0.537	0.215	0.232	0.304
n-octadecane	C18alk	0.331	0.133	0.668	0.267	0.166	0.302
Phytane	C20teralk	0.380	0.152	0.512	0.205	0.191	0.296
n-Nonadecane	C19alk	0.323	0.129	0.671	0.269	0.194	0.301
eicosane	C20alk	0.219	0.087	0.703	0.281	0.185	0.298
Heneicosane	C21alk	0.187	0.075	0.367	0.147	0.196	0.268
n-Docosane	C22alk	0.182	0.073	0.697	0.279	0.189	0.313
tricosane	C23alk	0.189	0.076	0.704	0.282	0.195	0.313
tetracosane	C24alk	0.216	0.086	0.780	0.312	0.196	0.305
n-Pentacosane	C25alk	0.248	0.099	0.904	0.362	0.195	0.338
n-hexacosane	C26alk	0.223	0.089	1.072	0.429	0.221	0.406

Table XX2. MC-252 alkane half life (days) from field and laboratory

		plume samples (2 d)	plume samples (5 d)	BP data (2 d)	BP data (5 d)	Mixed Consortia, 5°C	Micro-cosm water, 5°C
	Average	**2.4**	**6.1**	**1.2**	**2.9**	**3.5**	**2.2**
n-Tridecane	C13alk	1.6	4.0	1.4	3.5	3.1	2.1
n-Tetradecane	C14alk	1.5	3.8	1.4	3.4	3.5	2.3
Pentadecane	C15alk	1.5	3.8	1.0	2.4	3.6	2.1
n-hexadecane	C16alk	1.6	4.0	2.0	5.0	3.6	2.2
n-heptadecane	C17alk	1.7	4.3	1.1	2.8	3.6	2.3
Pristane	C19teralk	1.6	4.1	1.3	3.2	3.0	2.3
n-octadecane	C18alk	2.1	5.2	1.0	2.6	4.2	2.3
Phytane	C20teralk	1.8	4.6	1.4	3.4	3.6	2.3
n-Nonadecane	C19alk	2.1	5.4	1.0	2.6	3.6	2.3
eicosane	C20alk	3.2	7.9	1.0	2.5	3.7	2.3
Heneicosane	C21alk	3.7	9.3	1.9	4.7	3.5	2.6
n-Docosane	C22alk	3.8	9.5	1.0	2.5	3.7	2.2
tricosane	C23alk	3.7	9.2	1.0	2.5	3.6	2.2
tetracosane	C24alk	3.2	8.0	0.9	2.2	3.5	2.3
n-Pentacosane	C25alk	2.8	7.0	0.8	1.9	3.6	2.0
n-hexacosane	C26alk	3.1	7.8	0.6	1.6	3.1	1.7

Figure XX1. Correspondence analysis of alkanes with distance from the plume, fluorometry data, and AODC cell counts.



Atlas, R., Bragg, J., 2009. Bioremediation of marine oil spills" when and when not -- the Exxon Valdez experience. Microbial Biotechnology 2, 213-221.

Brakstad, O.G., Bonaunet, K., 2006. Biodegradation of petroleum hydrocarbons in seaswater at low temperatures (0-5C) and bacterial communities associated with degradation. Biodegradation 17, 71-82.

Coates, J. D., D. J. Lonergan, and D. R. Lovley. 1995. Desulfuromonas palmitatis sp. nov., a long-chain fatty acid oxidizing Fe(III) reducer from marine sediments. Arch. Microbiol. 164:406–413.

Hamilton, P. 1990. Deep currents in the Gulf of Mexico. Journal of Physical Oceanography, 20:1087-1104.MacNaughton, S.J., Stephen, J.R., Venosa, A.D., Davis, G.A., Chang, Y.-J., White, D.C., 1999. Microbial Population Changes during Bioremediation of an Experimental Oil Spill. Appl. Environ. Microbiol. 65, 3566-3574.

Venosa, A.D., Holder, E.L., 2007. Biodegradability of dispersed crude oil at two different temperatures. Marine Pollution Bulletin 54, 545-553.

Sincerely,

Terry C. Hazen

Terry C. Hazen, Ph. D.

DOE BER Distinguished Scientist
Senior Staff Scientist
Head, Ecology Department
Head, Center for Environmental Biotechnology
Co-Director, Virtual Institute Microbial Stress and Survival

Appendix 2
Estimating Biochemical Oxygen Demand of Dispersed Oil in the Deep Water

This appendix was created to provide a conceptual model to help explain or possibly visualize the impact biodegradation would have on the dissolved oxygen levels in the deep sea. The conceptual model encompasses the creation and evaluation of three scenarios that are intended to establish an upper and lower bound on the time needed for hypoxia to develop, assuming that no mixing occurs that would replenish the DO_2 lost to biodegradation. To accomplish this, the first task is to calculate the ultimate biochemical oxygen demand (BOD_{ult}) that is needed to support the first scenario.

Estimates from the published Federal Oil Budget Calculator[16] indicate that the total amount of oil that was dispersed into the water column each day, based on an oil flow rate of 6.0×10^4 bbl/d, was 1.44×10^4 bbl or 2.29×10^6 L (*i.e.*, 24% of the total). Assuming the specific gravity of SLC is 0.84 kg/L, the mass of oil dispersed was approximately 1.92×10^6 kg. Not all of that oil was biodegradable (asphaltenes, resins, and some saturated cyclic compounds are much more recalcitrant than the more biodegradable constituents). If we assume conservatively the SLC was approximately 80% biodegradable [based on a 2001 hydrocarbon constituent analysis by Environment Canada[17], which showed that unweathered SLC is comprised of 80.8% saturates, 12.6% aromatics, 6% resins, 0.8% asphaltenes, and 1.7% waxes and that each kg of oil biodegraded theoretically requires about 3.5 kg DO_2 for mineralization (based on stoichiometry)], the total ultimate biochemical oxygen demand (BOD_{ult}) would be approximately 5.38×10^6 kg DO_2 ($0.80 \times 1.92 \times 10^6$ kg oil x 3.5 kg DO_2/kg oil). For each day that oil leaked from MC252 into the Gulf of Mexico, approximately this amount of DO_2 is needed to facilitate the biodegradation of the oil entrained in the underwater plume.

If we assume the dispersed oil plume in a given day takes on the shape of a rectangle 300 m thick x 500 m wide x 2,400 m long (dimensions explained below), the amount of seawater in that volume is 360×10^9 L. This conceptual model tracks that volume to describe its behavior and effect on dissolved oxygen at depth based on DO_2 data and stoichiometric relationships and assumes no mixing, diffusion, or advection. The DO_2 concentration needed for complete mineralization of the oil in that volume of water is about 14.9 mg DO_2/L (5.38×10^6 kg DO_2 x 10^6 mg/kg / 360×10^9 L). This value is termed the ultimate BOD (BOD_{ult}). Although this plume is not static, it is assumed that the size of the putative rectangle is an average daily size. Thus, approximately 14.9 mg/L of DO_2 would need to be consumed to mineralize the biodegradable fraction of the oil contained in that volume of water.

In estimating the volume of water that corresponds to a 24-hour plume, the following assumptions were used:

---

[16] http://www.noaanews.noaa.gov/stories2010/PDFs/OilBudget_description_%2083final.pdf

[17] http://www.etc-cte.ec.gc.ca/databases/OilProperties/pdf/WEB_South_Louisiana_%282001%29.pdf

1. In the early parts of the incident (May and June), the observed plume near the well was confined between the depth of 1,000 and 1,300 meters. This suggests that the vertical thickness of the box should be about 300 meters.

2. The currents near the well were not steady or unidirectional, but from Acoustic Doppler Current Profiler (ADCP) data at approximately 1,100 meters from station #42916 (near the well head), a conservative estimate would give a displacement of about 2,400 meters a day. So, we can consider this as the length of the box. This is the value that corresponds to the lowest quartile of current speeds from May 2 - July 15, 2010.

3. Estimating the width was a bit more speculative, but the patchiness of the near field measurements suggests that near the source the plume was narrow and slightly filamentous. Considering the separation between stations that found an indication of the plume and those that did not, a reasonable estimate for the width of the plume is about 500 meters. Putting all these together, the daily loading from the subsurface portion of the spill would be distributed into 360 x 10^6 m^3 of water (360 x 10^9 L).

The following hypothetical scenarios are suggested as upper and lower bounds on estimating the time needed to reach hypoxia in the deep sea as a result of dispersing the DWH oil. These scenarios do not consider the exertion of BOD due to methane biodegradation because the total loading of methane into the deep water at the time of this report had not been estimated.

The first scenario uses the BOD equation[18] to make the calculations, which is expressed as

$$BOD_t = BOD_{ult}(1-\exp(-kt)) \qquad (1)$$

where BOD_t = BOD at time t,
BOD_{ult} is the ultimate BOD (14.9 mg/L as calculated above), and
k = first order rate coefficient for BOD exertion.

Using the average climatological DO_2 at depth of 6.9 mg/L and the lowest DO_2 measured before the well was capped of 4.2 mg/L (which occurred on Day 37 of the spill), the maximum amount of DO_2 consumed was 6.9 – 4.2 or 2.7 mg/L. Plugging that value into the BOD equation and using t = 37 days over which the BOD was exerted gives a rate of exertion of 0.0054/d. To calculate the time required to reach hypoxia, we first determine the DO_2 consumption needed to reach hypoxia, which is 6.9 – 2.0 or 4.9 mg/L. Using Equation 1 above with a k of 0.0054/d, the number of days needed to reach hypoxia is 74 days. To determine how sensitive this calculation is to the length of the plume, the same calculations above were made using ± 20% of the length. The days to hypoxia ranged from 72 to 76 d at those plume lengths, which closely bracket the 74 d time. Thus, this estimation method is fairly robust in terms of plume size effects on hypoxia.

[18]Metcalf and Eddy Inc. Wastewater engineering: treatment and reuse, Metcalf & Eddy Inc., 4th Edition; Tchobanoglous, G., Burton, F.L., Stensel, H.D., Eds.; McGraw-Hill Companies: New York, U.S.A., 2003.

The second scenario assumes a simpler, zero-order (or linear) consumption rate. Using the same DO_2 deficit value of 2.7 mg/L as in the first scenario and assuming that this deficit has been exerted over a period of 37 days, the BOD exertion rate results in 2.7 mg/L / 37 d or 0.073 mg/L/d. At that rate, it would take 67 d (6.9 – 2.0 or 4.9 mg/L / 0.073 mg/L/d) to reach hypoxia without DO_2 replenishment. This closely agrees with the 74 d calculated above using the BOD equation. These values represent the upper bound in time needed to reach hypoxia *assuming no mixing across the plume boundaries and therefore no DO_2 replenishment*. With mixing, however, the DO_2 levels would be constantly replenishing the deficits, so hypoxia is unlikely if these assumptions are valid.

The lower bound was estimated in the third scenario in terms of calculating the BOD in the total plume. Since this scenario uses a different rate law than the first scenario, we need to re-calculate the BOD_{ult} based on zero-order biodegradation kinetics. Again using the oil budget calculator, the total amount of oil that was dispersed chemically and physically both from deep sea injection and surface application was about 24% of the total volume of oil spilled. This amounts to 6.0 x 10^4 bbl/d x 42 gal/bbl x 0.24 x 87 d x 3.785 L/gal or 1.99 x 10^8 L oil dispersed. Assuming the specific gravity of SLC is 0.84 kg/L, the mass of oil dispersed is 1.67 x 10^8 kg. Assuming the SLC is 80% biodegradable and that each kg of oil biodegraded theoretically requires about 3.5 kg DO_2 for mineralization, the total BOD would be 4.68 x 10^8 kg DO_2. If we assume the dispersed oil plume takes on the shape of a polygon 300 m thick x 500 m per side near the well head x 5,000 m per side at a distance of 32 km from the well head, the amount of seawater in that volume is 2.64 x 10^{13} L. Thus, the DO_2 concentration needed for complete mineralization of the oil in that volume of water is 17.7 mg/L (4.68 x 10^8 kg x 10^6 mg/kg / 2.64 x 10^{13} L). If that demand is exerted over a period of 87 d, (which was the duration of the spill), again assuming a zero-order rate behavior, the amount of DO_2 needed to satisfy that demand would be 0.203 mg/L/d (17.7 mg/L / 87 d). Using that rate of exertion, it would take 24 days (6.9 – 2.0 = 4.9 mg/L / 0.203 mg/L/d) to reach hypoxic levels assuming the lost DO_2 was not replenished at all. This scenario represents the lower bound in terms of days to hypoxia.

To test the sensitivity of the third scenario to plume length, we impose a ± 20% variation to that dimension (25.6 to 38.4 km). At 25.6 km plume length, the days to hypoxia would be 19 d, while at 38.4 km length, the days to hypoxia would be 29 d. Thus, this estimation method is also fairly robust in terms of plume size effects on hypoxia.

The scenarios above assumed 80% of the whole oil was biodegrading, not just relatively labile alkanes. For comparison, the first-order biodegradation rate constant for total alkanes determined in EPA's 2007 laboratory study[10] was 0.138/d and for PAHs was 0.057/d. The alkane first-order rate coefficient is more than 25-fold greater than the first-order rate calculated from the BOD equation above, and the PAH rate coefficient is 10-fold greater. This was despite the fact that the oil used in that study was a medium weight crude oil (Prudhoe Bay crude), which would be slightly less biodegradable than SLC. Data collected from the R/V *Ocean Veritas* and R/V

Brooks McCall by Hazen's Lawrence Berkeley group[19] showed that the alkane biodegradation rate coefficient (0.310/day) was about double that reported by the 2007 EPA study. Using the same BOD consumption of 2.7 mg/L as in the second scenario, the time to hypoxia using the first-order alkane and PAH rate coefficients from the EPA laboratory study is 2.9 and 7.0 d, respectively, whereas using the Lawrence Berkeley group's first-order rate constant, only 1.3 d is needed to reach hypoxia. Again, these times assume no mixing or DO_2 replenishment.

In summary, three hypothetical scenarios were tested to determine the length of time needed for biodegradation to cause hypoxia in the deep sea ecosystem of the Gulf of Mexico. Scenarios 1 and 2 differed by the rate law imposed on the system (Scenario 1 used a 1st-order rate coefficient from the BOD equation while Scenario 2 used a zero-order rate coefficient). Yet both scenarios would result in 74 and 68 days, respectively, to achieve hypoxia, assuming that no mixing occurred that would replenish the diminished dissolved oxygen. Both methods were robust in terms of their sensitivity to the volume of the plume. These scenarios represent the upper bound in terms of time for causing hypoxic conditions in the deep sea because they were developed using a daily plume size. The third scenario took a slightly different approach in terms of the size of the plume. In this scenario, the entire mass of dispersed oil was subjected to biodegradation in a plume that reached a total volume of 2.64×10^{13} L over the 87-d duration of the spill rather than a volume created in one day, growing stepwise each day of the spill as in the first and second scenarios. In this scenario, the lower bound of 24 days to reach hypoxia resulted from the imposed conditions, which used a plume size developed over the entire duration of the spill (87 days). This scenario was also robust in terms of its lack of sensitivity to plume length. The temporal difference between the lower and upper bounds for these scenarios was approximately three-fold. At the time of this writing, it has been 129 days since the spill first occurred, yet the DO_2 concentration has not approached hypoxic levels. This likely indicates that the assumption of no mixing to replenish DO_2 from the surrounding higher DO_2-containing waters was incorrect. Mixing due to both advection and diffusion must be occurring to provide sufficient electron acceptor not only to support biodegradation of the oil hydrocarbons but also to replenish the deficit caused by that metabolism in the dispersed oil plume.

The analyses above include numerous assumptions and are provided as preliminary estimates based on expected rates of exertion of BOD, the low level of hydrocarbons present in the deep sea, the unknown nutrient concentrations available to support biodegradation, and the size of the dispersed oil plume estimated from measured ocean currents. A further unknown at present is the rate of diffusion and/or advection of dissolved oxygen from the surrounding DO_2-rich waters to the inner depths of the plume where DO_2 deficits have been observed. Lateral diffusivity of DO_2 is expected to be much greater than vertical diffusivity, but replenishment of the inner deficit due to diffusion is always much lower than advective forces from mixing of the waters at depth. Once we achieve a better understanding of these diffusive and advective forces, we will be in a better position to verify the above estimates. The estimates are conservative in terms of percent

[19] Refer to Appendix 1

biodegradability of the SLC oil and the size of the dispersed oil plume but provide reasonable outcomes to scenarios in which biodegradation is occurring in the deep water. In none of the scenarios would hypoxia occur as a result of biodegradation of the dispersed oil. This latter statement has held true since the beginning of the spill.

The times to hypoxia based on the 2007 EPA laboratory study and the Hazen Lawrence-Berkeley group's analysis of deep sea biodegradation are substantially lower than the lower bound scenario described above. This could be due to many factors. The mesophilic microbial community in the EPA study, which was originally isolated from Prince William Sound in 1990 a year after the Exxon Valdez incident, was undoubtedly different in numerous aspects from that of the Lawrence-Berkeley group's, not the least of which was the psychrophilic nature of the Lawrence-Berkeley group's culture. Second, extrapolation from laboratory studies to the field is always fraught with uncertainties since microorganisms grow much better in the optimized environment of laboratory microcosms with little or no nutrient or oxygen limitations. Third, the Lawrence-Berkeley group's results are somewhat surprising and rather unexpected since the rates of biodegradation and half-lives of the various alkanes shown in Tables XX1 and XX2 in Appendix 2 of this report were similar for virtually all carbon numbers. Usually, as molecular weight increases, biodegradation rates decrease. It is possible that at least some of the observed disappearance of alkanes in that study might have been due to physical factors rather than biological, such as dilution effects. Also, their estimates are based on rapid rates of biodegradation observed for the least recalcitrant fraction (alkanes) of the oil rather than on the complex mixture of compounds that characterize SLC oil. This is understandable since only the alkanes were high enough in concentration to enable quantification. Nonetheless, we will be undoubtedly learning much more in the months to come as we continue to monitor the changes that are occurring in the deep sea.

Appendix 3
Dissolved oxygen measurement methods aboard the R/V *Brooks McCall* May 2010[1]

The RV Brooks McCall has been onsite at the MS Canyon 252 on three separate occasions during May, 2010. The dissolved oxygen data has been collected using several methods throughout these three segments.

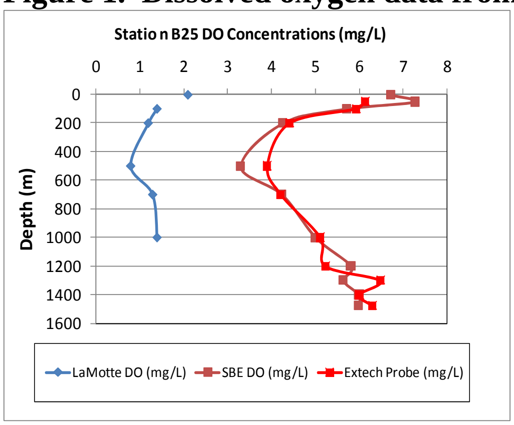
Segment 1: May 8, 2010 – May 12, 2010

On this cruise no profiling DO_2 sensor was deployed. All data from this cruise segment was acquired with the LaMotte 5860 DO_2 Field Kit. Three Niskin bottles were available, and samples were collected at 1 m, 275 m, and 550 m depths. DO_2 results with the LaMotte kit could not be compared to other available instrumentation.

Segment 2: May 13 – May 17, 2010

A new CTD unit with full ocean depth rating was acquired while in port, including a SBE DO_2 Sensor. DO_2 profiles were acquired with each cast. It was also discovered that an Extech DO700 handheld probe was available, and this was used to perform some measurements in an attempt to validate the SBE data and the LaMotte data. The Extech probe generally showed good agreement with the SBE data for the corresponding depth; however, the LaMotte Field kit data was significantly lower and did not appear to represent the structure of the dissolved oxygen profile as seen with the SBE instrument and replicated with the Extech probe. Figure 1 presents the results from Station B25 data. The agreement between the Extech probe and the SBE sensor appeared quite good while the LaMotte kit results were quite different. As a result of the lack of agreement observed by the LaMotte kit, it was believed that the Extech probe was providing more reliable results.

Figure 1. Dissolved oxygen data from station B25



Segment 3: May 19 – present

Dissolved oxygen measurements during Segment 3 were initially performed with the Extech probe and verification with the SBE data. A request was made to perform a series of colorimetric tests using fresh LaMotte kits and replicate samples. Three samples were collected

from the same Niskin bottle at two depths. Each of the samples was analyzed using a separate LaMotte kit. Extech probe measurements were also made. This was performed for three separate stations. The data are presented in the following figures. Station B35 showed reasonable agreement between all three dissolved oxygen methodologies, but stations B34 and B37 showed poorer agreement. The results from the LaMotte kits showed a larger range of variability overall.

Figure 2. Station B34 Dissolved Oxygen Data

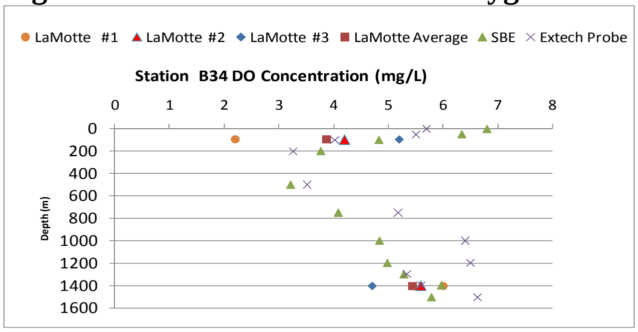


Figure 3 Station B35 Dissolved Oxygen Data

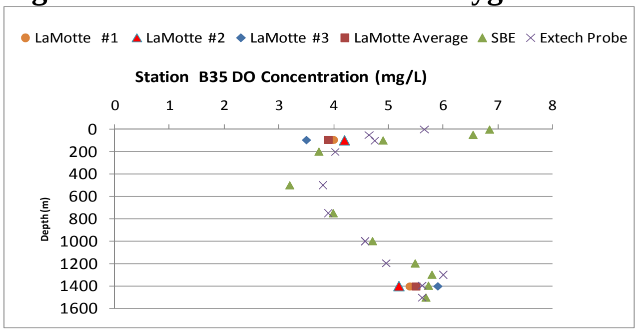
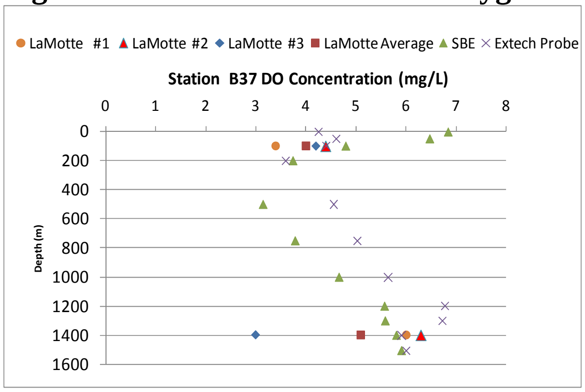


Figure 4. Station B35 Dissolved Oxygen Data



A more suitable method for validating both the SBE sensor and Extech probe data would be to employ a true Winkler titration system for these shipboard measurements, or preserve samples onboard for outside analysis. The results from these analyses indicate normal, typical levels of dissolved oxygen for the Gulf of Mexico. The low dissolved oxygen values from previous LaMotte kit measurements may be the result of reagent degradation or operator error.

Appendix 4
Methods for Data Quality Control and Processing

August 6, 2010 – R/V *Brooks McCall* Status Report - Cruise 16 - Day 3
Complied by: Leigh Stevens, Ecosystem Management and Associates (for BP)

Day 3 sampling focused on collection and analysis of DO_2 samples from a range of depths using automated titration methods, and tracking of the subsurface plume signals to the SW and WSW of the wellhead. A total of 6 CTD casts were completed, as summarized below and shown in Figure 1. No surface oiling was observed.

Station	Position from wellhead	Fluorescence signal	Signal depth	Comment
BM162	75 km SW of the wellhead	No signal	-	A minor reduction in DO_2 (~0.2mg/L) evident over 40m with a peak at 1145m.
BM163	77 km WSW of the wellhead	No signal	-	A reduction in DO_2 (~0.5mg/L) evident over 70m between 1085m and the seabed.
BM164	85 km WSW of the wellhead	No signal	-	A reduction in DO_2 (~0.2mg/L) evident over 50m between 1150m and the seabed.
BM165	87 km WSW	No signal	-	No reduction in DO_2 compared to background.
BM166	90 km WSW	No signal	-	No reduction in DO_2 compared to background.
BM167	125 km WSW	No signal	-	No reduction in DO_2 compared to background.

Three of the days 6 casts showed a minor decrease in DO_2 compared to background values at depths where the dispersed oil plume has been consistently located previously. There was no change apparent in the background fluorometry signal, and no indicators of oil in the LISST or fluorometry data.

Much of the day's focus has been on compiling the DO_2 data from the multiple measures undertaken on board. Today, 12 water samples were collected and analyzed using the modified Winkler

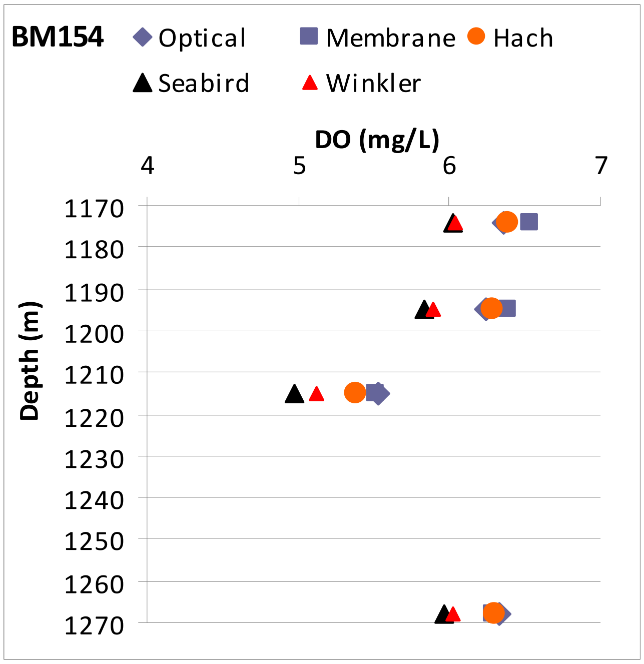
titrations to measure dissolved oxygen, 1 from >1000 m and 11 from < 1000 m. This was to achieve the 60:40 sampling ratio specified in Addendum 4 and included two additional samples. These were added because one Winkler sample collected in the morning was unable to be analyzed due to the addition of the wrong reagent during lab preparation, and another as post-processing would have been required to extract a data point from the software, which had a minor malfunction yesterday. Because of these factors, two partial data rows (SW-20100805BM16-1, SW-20100806BM16-3) were excluded to provide a balanced paired analysis. In total, during this and the previous cruise, the Brooks McCall has now conducted 100 modified Winkler titrations, excluding lab duplicates and standards. Lab standards showed the Winkler and Hach tests were capable of measuring to below 2 mg/L. The Ocean Veritas has completed 86 modified Winkler titrations.
Addendum 4, Additional Requirement 4 requests a correlation between the automated Winkler titration and the probe measurements. Brooks McCall Cruise 16 paired sample correlation values are presented below:

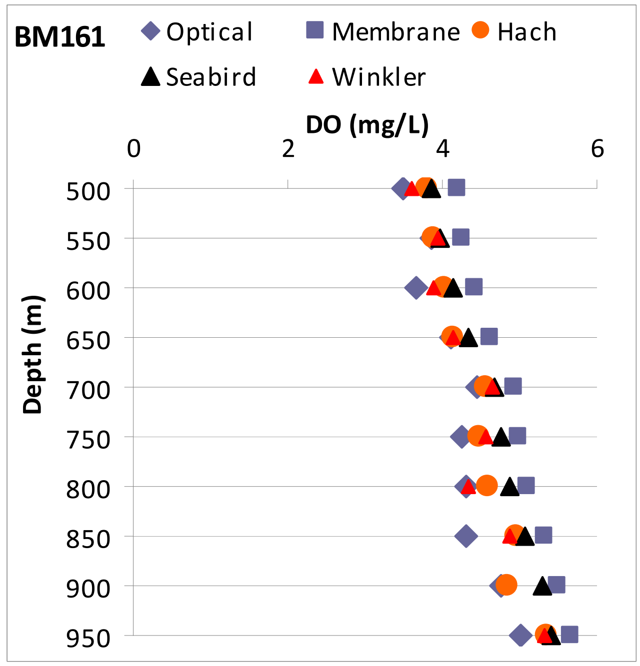
Correlation	Seabird	Hach	Optical	Membrane
Winkler	0.83	0.86	0.75	0.81
Seabird		0.96	0.92	0.88
Hach			0.91	0.93
Optical				0.74

These correlation values show a very good relationship exists between the Seabird CTD DO_2 probe, and the other measures, particularly the Hach modified Winkler titration. The larger combined data set of Cruise 15 and 16 has not been presented as it does not include University of Miami/NOAA Winkler results, but shows a very similar outcome. The Ocean Veritas data also provide a very similar result. This extensive combined data set provides compelling evidence that the Seabird sensors are returning accurate measures of DO_2.

This conclusion is further reinforced by the ability of the sensors to measure DO_2 concentrations consistent with pre-spill conditions in the Gulf of Mexico in the upper part of a cast, then show a clear decrease in DO_2 as it passes through dispersed subsurface oil before returning to background values below the subsurface plume. This pattern has then been consistently repeated in the upcast. The ability of the sensor to repeatedly return to background DO_2 concentrations after passing through subsurface oil provides strong evidence that the CTD DO_2 sensor is not being compromised.

Representative examples of the data from Cruise 16 are presented below. Sampling within the residual subsurface plume targeted dips in DO_2. Station BM154 shows how all the measures used were able to measure the shift from background concentrations to a low point (1215 m) in a DO_2 depression accurately. Station BM161 shows the consistent relationship with measures through the water column at 50 m intervals.





Data have been submitted with the daily deliverables. No regression analyses have been performed as the data already tell such a clear story that further analysis is not considered likely to alter the conclusion in any meaningful way.

Throughout this sampling effort on the Brooks McCall the JAG would like to formally acknowledge the huge effort and contribution put in by Research Associate George Berberian (University of Miami/NOAA), Sean Kane (NOAA Environmental Scientist), and Ed Morren (Senior Scientist, Shaw Environmental). Their technical expertise, professionalism, integrity, and willingness to resolve this key question have been exemplary. The JAG would also like to acknowledge the input and feedback of the on board observers, Dr. Ken Lee, Senior Research Scientist, DFO Canada - and member of the JAG, and Kevin Larsen, EPA On-Scene Coordinator, Region 7.

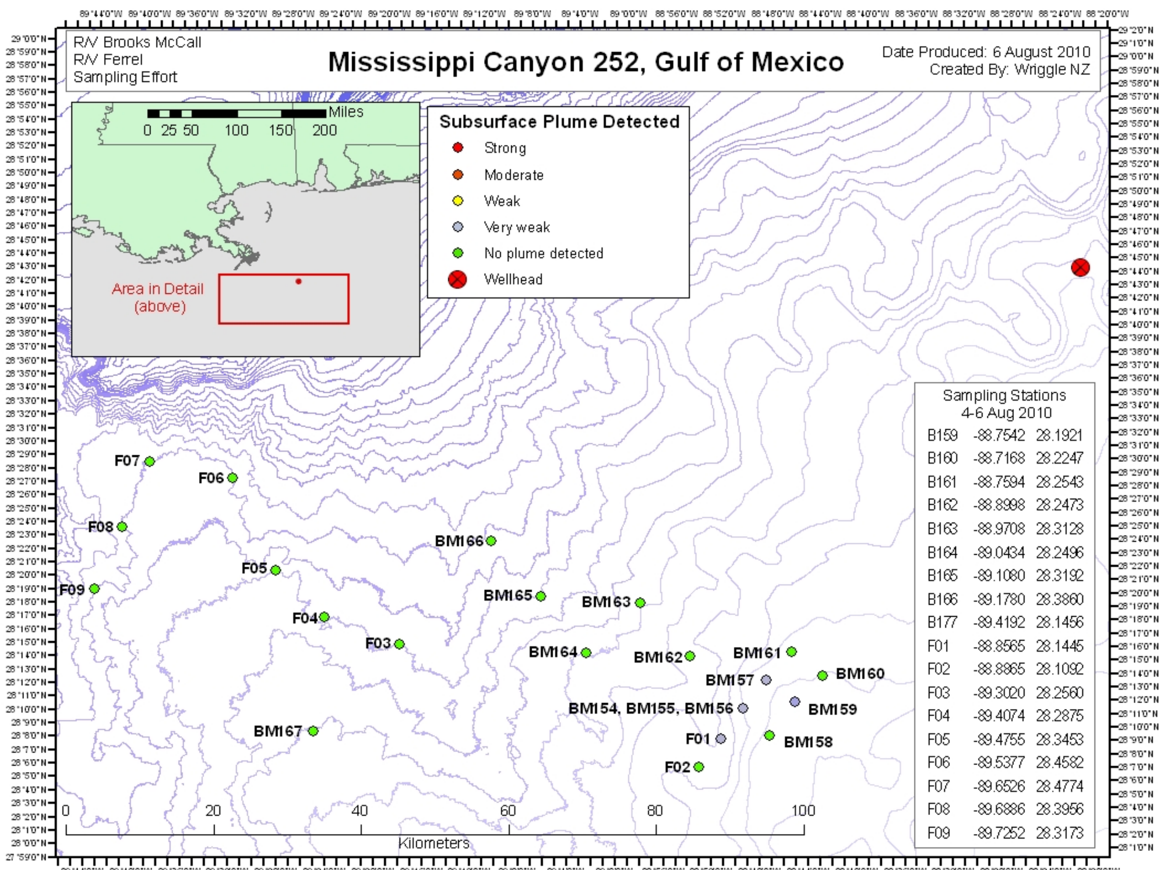
VOC monitoring has been undertaken regularly throughout the day by Josh Senter, Bureau Veritas Industrial Hygiene Specialist. No VOCs were detected above background. Again, the greatest concern today has been heat, which has been monitored and managed appropriately.

Rotox tests were completed for samples BM158 through BM161. No toxicity was apparent in any samples. Rotox tests were started for samples BM163 through BM166 (results due to be reported on 7 August 2010).

The days sampling struggled to find the residual plume identified yesterday. At water depths lower than 1000 m, the depth of the minor subsurface DO_2 signal was measured in contact with the seabed and was sampled. No residual oil was indicated at concentrations detectable by fluorescence.

The following definition has been adopted to provide common terminology on how subsurface oil is referred to:

Oil Plume: “Concentration of oil (above background) in the water column that appears to be part of a larger pattern of dispersed oil based on real-time fluorometry and LISST particle data analysis.”



General CTD Processing

In order to provide consistency across different ships, sensors, and personnel, conductivity-temperature-depth (CTD) data available to the JAG are being reprocessed from raw instrument files. To date, all CTD's being used have been manufactured by Seabird Electronics. Binary data files (hex or dat) and configuration files (con) were obtained for all casts and reprocessed at NODC using Seabird Electronics Data Processing Software version 7.20d released May 27, 2010. Raw files (all scans) were initially plotted and examined visually for instrument response issues. Following that examination, the SeaBird processing routine "Wildedit" was used with the following recommended settings to remove spikes in the data based on statistics of blocks of individual scans. *[Standard deviation for pass one: 2; Standard deviation for pass two 20; Scans block: 100; Keep data within this distance of the mean: 0; Exclude scans marked bad: yes (check)]*

Data were then pressure averaged, and files (1 dbar) for the downcast were created and plotted for a 'quicklook' review by the JAG members. Separate data files were created for comparing CTD observations to water-sample data collected concurrently using Niskin sampling bottles. These "bottle files" contain CTD observations extracted for the known depths of the Niskin bottle samples using both downcast and upcast data from the CTD. Because the water analyses are being done at different labs and require some time to complete, the bottle files are updated over time as laboratory results are received.

Initial Quality Control (QC) of the CTD casts are being conducted following a subset of checks outlined in the Global Temperature and Salinity Profile Program Real-Time Quality Control Manual (UNESCO, 2009). The following QC checks are being conducted on the temperature and salinity profiles

1. Spike
2. Top and Bottom Spike
3. Gradient
4. Density Inversion.

QC Flags are being assigned to the individual temperature and salinity observations following the GTSPP procedures and nomenclature.

The coincident CTD profiles of Chromophoric Dissolved Organic Matter (CDOM) fluorescence and dissolved oxygen have not been quantitatively subjected to QC checks to date. The JAG is examining the instrument response, additional sample verification, and calibration of these sensors relative to hydrocarbons dispersed in the water column.

All CTD data are being converted to a net CDF format (CF convention) for use by JAG members as well as additional data assembly into flat files for use by GIS and visualization software including Fledermaus. Final plots of cast and sample data are being produced for the JAG as requested.

The CTD data and available bottle data are being collated for archive at NOAA's National Oceanographic Data Center (NODC). All preliminary CTD data is also being preserved at NODC. Profile data will be subjected to additional QC checks as part of ingest into the World Ocean Database at NODC.

Chromophoric Dissolved Organic Matter (CDOM) Fluorescence

To allow valid comparisons, the following method was applied to normalize the CDOM fluorescence data among all vessels, cruises, and instruments discussed in the JAG report. A least squares linear fit was determined for each CDOM fluorescence profile between 200 and 900 m. The derived linear fit was extended through the bottom of the cast to serve as the representation of an expected linear profile of CDOM fluorescence in the region (personal communication, Robert Chen, July 6, 2010).

This linear profile was subtracted from the observed profile, and all negative values were set to zero. Statistics on the normalized profile were then calculated for depths between 1000-1300 m where the CDOM positive anomalies were observed in the individual casts.

Dissolved Oxygen Profiles from SBE43

To date, calibration of the SeaBird Electronics SBE43 Dissolved Oxygen Sensor, a Clark polarographic membrane type sensor, has not been attempted using Winkler bottle data techniques. Only sparse Winkler titration results from water samples collected are available from the Deepwater Horizon Response subsurface monitoring effort. These data are insufficient to support a broad comparison of the oxygen data collected since mid-May 2010.

During CTD processing, recommended procedures following Seabird Electronics Application Note 64-3 (SBE 43 Dissolved Oxygen (DO) Sensor -- Hysteresis Corrections) were used as outlined under "Data conversion module when Winkler Bottle Data are NOT Available." Basic statistics on the oxygen were calculated over the 1000-1300 m range for each cast having a corresponding CDOM fluorescence profile extending to the minimum depth of 1300 m.

Historical Winkler titration data from in the National Oceanographic Data Center World Ocean Atlas (WOA) 1^{o} climatology was extracted in for the grid corresponding to the MC252 spill location and used as a basis for comparison to dissolved oxygen profiles.

Alignment to climatological and canonical profiles was evaluated for purposes of comparative analysis by the JAG. For the climatological approach, a least-squares fit between cruise-level mean profiles and the WOA values between 500-800 m was generated to evaluate systematic offsets. Using NOAA Ship *Nancy Foster* Station 69 as a basis for a canonical profile, a similar linear alignment procedure was evaluated.   This Nancy Foster station was selected as far-field profile outside the influence of the MC252 spill (~140 km).   Waterfall plots of resulting "aligned "profiles from all ships and cruise were evaluated and these techniques proved insufficient to allow for robust comparative analysis.   The influence of the MC252 spill on the deeper portion oxygen profiles did not allow for more traditional approaches for alignment using the typically more stable deeper values.   In addition, the NOAA Ship *Nancy Foster* Mission Summary Report (*NF1013 -- Monitoring and Assessing Implications of the Deepwater Horizon Oil Spill: Potential Impacts of the Loop Current on Downstream Marine Ecosystems in the Gulf of Mexico and Florida Straits July 26, 2010*) reported "*a slight deviation to the broader slope of the CTD DO_2 sensor profiles recorded between 800 m and 1000 m depth*" at 84 km from the wellhead.   Changes in the slope of the oxygen profile independent of depressions or calibration differences could be responsible for the alignment shortcomings.

In addition, dissolved oxygen profiles were vertically integrated over selected depth regimes to examine net changes in oxygen content over these regions as a result of the observed dissolved oxygen depressions. While informative on an individual cruise basis, this technique did not provide a basis for comparison of integrated profiles between cruises or different ships, which is attributed to calibration differences. This technique does provide for the range of integrated oxygen values during the subsurface monitoring effort.

Data Availability

Data from the subsurface monitoring associated with MC252 spill is accessible through the National Oceanographic Data Center at:

http://www.nodc.noaa.gov/General/DeepwaterHorizon/oceanprofile.html

Notes

Responsible NODC Divisions: Ocean Climate Laboratory (OC5) and National Coastal Data Development Center (OC6)

Appendix 5: QA / QC JAG Oxygen Data

Vessel	CruiseID	StationID	StationName	StationLat	StationLon	SampleDate	DateString	DepthOfCast	Dist2Wellhead	DO2_MEAN	DO2_MIN	DO2_SDEV	CDOM_MEAN	CDOM_MAX	CDOM_SDEV	CDOM_INT
Jack Fitz	1		JF001-C1	28.900000	-88.200000	05.10.2010	MAY 10 2010	587	24223.51	-99	-99	-99	-99	-99	-99	-99
Jack Fitz	1		JF002-C1	29.086500	-88.023667	05.11.2010	MAY 11 2010	376	51156.52	-99	-99	-99	-99	-99	-99	-99
Jack Fitz	1		JF003-C1	28.726667	-88.287500	05.12.2010	MAY 12 2010	587	7784.90	-99	-99	-99	-99	-99	-99	-99
Jack Fitz	1		JF004-C1	28.736167	-88.325833	05.13.2010	MAY 13 2010	553	3932.86	-99	-99	-99	-99	-99	-99	-99
Jack Fitz	1		JF005-C1	28.737667	-88.346167	05.14.2010	MAY 14 2010	564	1936.90	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	3	2010_0519_BM29	BM29	28.686927	-88.423675	05.19.2010	MAY 19 2010	1321	8018.92	4.02	3.67	0.18	0.01	0.41	0.03	1.64
Brooks McCall	3	2010_0519_BM30	BM30	28.661077	-88.452337	05.19.2010	MAY 19 2010	1321	12034.11	4.03	3.71	0.15	0.15	2.95	0.44	45.62
Brooks McCall	3	2010_0519_BM31	BM31	28.644125	-88.426667	05.19.2010	MAY 19 2010	1321	12016.22	4.26	3.91	0.18	0	0.14	0.02	1.07
Brooks McCall	3	2010_0519_BM32	BM32	28.683275	-88.472140	05.19.2010	MAY 19 2010	1331	12051.60	3.92	3.63	0.13	0.57	8.01	1.2	172.59
Brooks McCall	3	2010_0519_BM33	BM33	28.709278	-88.484742	05.19.2010	MAY 19 2010	1331	12063.66	4.19	3.56	0.19	0.14	1.66	0.36	43.2
Brooks McCall	3	2010_0520_BM34	BM34	28.715970	-88.394468	05.20.2010	MAY 20 2010	1494	3722.99	4.03	3.59	0.18	0.09	1.96	0.35	27.98
Brooks McCall	3	2010_0520_BM35	BM35	28.728845	-88.380308	05.20.2010	MAY 20 2010	1494	1744.37	4.04	3.63	0.19	0.01	0.79	0.07	3.76
Brooks McCall	3	2010_0520_BM36	BM36	28.732025	-88.376757	05.20.2010	MAY 20 2010	1494	1257.55	4.01	3.64	0.18	1.13	12.94	2.62	341.02
Brooks McCall	3	2010_0520_BM37	BM37	28.729572	-88.366363	05.20.2010	MAY 20 2010	1520	952.54	3.93	3.54	0.16	0.09	4.87	0.52	28.38
Brooks McCall	3	2010_0521_BM38	BM38	28.732028	-88.376727	05.21.2010	MAY 21 2010	1545	1254.88	3.98	3.54	0.2	1.07	12.28	2.84	321.09
Brooks McCall	3	2010_0521_BM39	BM39	28.738703	-88.351128	05.21.2010	MAY 21 2010	1544	1451.81	4.01	3.43	0.26	0	0.15	0.01	0.8
Brooks McCall	3	2010_0521_BM40	BM40	28.752020	-88.366777	05.21.2010	MAY 21 2010	1454	1543.77	4.22	3.86	0.19	0	0.15	0.01	0.86
Brooks McCall	3	2010_0521_BM41	BM41	28.738343	-88.386970	05.21.2010	MAY 21 2010	1495	2058.24	4.23	3.85	0.2	4.09	16.64	4.44	1224.56
Jack Fitz	2		JF001-C2	28.875500	-88.388667	05.22.2010	MAY 22 2010	64	15417.23	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	4	2010_0523_BM42	BM42	28.732012	-88.376773	05.23.2010	MAY 23 2010	1541	1259.72	4.07	3.72	0.13	4.77	13.77	3.84	1434.87
Brooks McCall	4	2010_0523_BM43	BM43	28.738353	-88.386910	05.23.2010	MAY 23 2010	1489	2052.38	-99	-99	-99	1	7.64	2.01	302.33
Brooks McCall	4	2010_0523_BM44	BM44	28.735127	-88.381882	05.23.2010	MAY 23 2010	1510	1595.54	4.25	3.86	0.2	3.84	12.79	3.41	1153.93
Jack Fitz	2		JF002-C2	28.875500	-88.388667	05.23.2010	MAY 23 2010	201	15417.23	-99	-99	-99	-99	-99	-99	-99
Jack Fitz	2		JF003-C2	28.768500	-88.442500	05.23.2010	MAY 23 2010	550	8216.42	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	4	2010_0524_BM45	BM45	28.738112	-88.407622	05.24.2010	MAY 24 2010	1488	4079.68	4.22	3.92	0.17	1.87	12.17	3.03	561.88
Brooks McCall	4	2010_0524_BM46	BM46	28.728288	-88.400982	05.24.2010	MAY 24 2010	1535	3600.17	4.03	3.75	0.12	2.22	9.8	2.38	669.17
Brooks McCall	4	2010_0524_BM47	BM47	28.719117	-88.391078	05.24.2010	MAY 24 2010	1564	3243.18	3.98	3.56	0.19	0	0.08	0.01	0.24
Brooks McCall	4	2010_0524_BM48	BM48	28.735058	-88.429200	05.24.2010	MAY 24 2010	1494	6201.44	3.96	3.59	0.15	1.36	6.66	1.85	409.98
Jack Fitz	2		JF004-C2	28.746667	-88.385333	05.24.2010	MAY 24 2010	215	2120.99	-99	-99	-99	-99	-99	-99	-99
Jack Fitz	2		JF005-C2	28.753833	-88.404500	05.24.2010	MAY 24 2010	1422	4156.89	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	4	2010_0525_BM49	BM49	28.721390	-88.420077	05.25.2010	MAY 25 2010	1528	5616.33	4.02	3.63	0.17	1.47	8.43	1.88	443.46
Brooks McCall	4	2010_0525_BM50	BM50	28.717822	-88.429587	05.25.2010	MAY 25 2010	1512	6626.43	4.17	3.93	0.11	0.91	6.32	1.45	275.28
Brooks McCall	4	2010_0525_BM51	BM51	28.737658	-88.439887	05.25.2010	MAY 25 2010	1473	7238.17	4.12	3.68	0.12	0.45	7.36	1.31	135.53
Brooks McCall	4	2010_0525_BM52	BM52	28.732007	-88.376787	05.25.2010	MAY 25 2010	1541	1261.12	4.1	3.88	0.1	0.03	2.34	0.23	10.13
Jack Fitz	2		JF006-C2	28.746769	-88.385395	05.25.2010	MAY 25 2010	-99	2131.53	-99	-99	-99	-99	-99	-99	-99
Walton Smith	1	2010_0526_WS01A	WS001	28.715833	-88.408333	05.26.2010	MAY 26 2010	1537	4833.08	4.17	3.84	0.18	0	0.05	0.01	0.57
Walton Smith	1	2010_0526_WS01B	WS001	28.714333	-88.406667	05.26.2010	MAY 26 2010	1447	4783.78	4.19	3.85	0.19	0	0	0	0
Walton Smith	1	2010_0526_WS01C	WS001	28.713667	-88.407000	05.26.2010	MAY 26 2010	1239	4852.11	-99	-99	-99	-99	-99	-99	-99
Walton Smith	1	2010_0526_WS02A	WS002	28.730667	-88.409333	05.26.2010	MAY 26 2010	1513	4327.72	4.18	3.81	0.19	2.12	7.39	2.08	633.08
Walton Smith	1	2010_0526_WS03A	WS003	28.741000	-88.408500	05.26.2010	MAY 26 2010	1444	4177.69	4.2	3.87	0.17	0.07	2.67	0.32	20.59
Jack Fitz	2		JF007-C2	28.749333	-88.383500	05.27.2010	MAY 27 2010	261	2120.92	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	1	2010-0527-OV002	OV002	28.797300	-88.758706	05.27.2010	MAY 27 2010	1021	38986.54	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	1	2010-0527-OV003	OV003	28.666022	-88.756806	05.27.2010	MAY 27 2010	1021	39096.14	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	1	2010-0527-OV004	OV004	28.676717	-88.362856	05.27.2010	MAY 27 2010	1400	6828.84	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	2	2010-0603-TJ01	TJ01	28.856667	-89.358333	05.27.2010	MAY 27 2010	55	97930.22	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	2	2010-0603-TJ02	TJ02	28.726333	-89.005000	05.27.2010	MAY 27 2010	600	62554.47	-99	-99	-99	-99	-99	-99	-99
Walton Smith	1	2010_0527_WS04A	WS004	28.724000	-88.408333	05.27.2010	MAY 27 2010	1530	4436.85	4.19	3.85	0.17	0.85	3.17	0.81	256.19
Walton Smith	1	2010_0527_WS05A	WS005	28.729667	-88.420333	05.27.2010	MAY 27 2010	1503	5406.72	4.19	3.84	0.18	1.82	8.42	1.61	545.18
Walton Smith	1	2010_0527_WS06A	WS006	28.725667	-88.426333	05.27.2010	MAY 27 2010	1510	6071.79	4.2	3.84	0.18	1.69	10.05	2.1	508.69
Walton Smith	1	2010_0527_WS07A	WS007	28.724500	-88.432833	05.27.2010	MAY 27 2010	1496	6720.92	4.17	3.84	0.19	1.96	9.32	1.83	587.77
Walton Smith	1	2010_0527_WS08A	WS008	28.723167	-88.442167	05.27.2010	MAY 27 2010	1474	7644.73	4.16	3.87	0.18	0.81	2.17	0.59	242.87
Walton Smith	1	2010_0527_WS09A	WS009	28.720833	-88.449167	05.27.2010	MAY 27 2010	1441	8370.66	4.16	3.83	0.18	0.91	2.78	0.6	273.28
Walton Smith	1	2010_0527_WS10A	WS010	28.718667	-88.457667	05.27.2010	MAY 27 2010	1381	9235.94	4.19	3.86	0.16	0.58	1.75	0.57	174.21

Appendix 5: QA / QC JAG Oxygen Data

Vessel	CruiseID	StationID	StationName	StationLat	StationLon	SampleDate	DateString	DepthOfCast	Dist2Wellhead	DO2_MEAN	DO2_MIN	DO2_SDEV	CDOM_MEAN	CDOM_MAX	CDOM_SDEV	CDOM_INT
Walton Smith	1	2010_0527_WS11A	WS011	28.718167	-88.465333	05.27.2010	MAY 27 2010	1301	9979.33	4.19	3.85	0.17	0.34	1.66	0.44	102.72
Walton Smith	1	2010_0527_WS12A	WS012	28.723500	-88.484000	05.27.2010	MAY 27 2010	1355	11670.45	4.04	3.39	0.28	0.83	3.37	0.88	248.8
Walton Smith	1	2010_0527_WS12B	WS012	28.723000	-88.482333	05.27.2010	MAY 27 2010	1359	11516.93	4.07	3.46	0.26	0.57	2.16	0.67	172.46
Walton Smith	1	2010_0527_WS13A	WS013	28.827333	-88.813333	05.27.2010	MAY 27 2010	678	44873.08	-99	-99	-99	-99	-99	-99	-99
Walton Smith	1	2010_0527_WS14A	WS014	28.707167	-88.516500	05.27.2010	MAY 27 2010	1299	15135.11	4.15	3.83	0.17	0.14	1.88	0.29	41.21
Walton Smith	1	2010_0527_WS15A	WS015	28.701833	-88.539667	05.27.2010	MAY 27 2010	1319	17478.66	4.01	2.96	0.35	0.32	2.31	0.57	96.09
Gordon Gunter	1		001-H	28.909000	-88.786000	05.28.2010	MAY 28 2010	358	45247.03	-99	-99	-99	-99	-99	-99	-99
Jack Fitz	2		JF008-C2	28.754333	-88.392167	05.28.2010	MAY 28 2010	260	3134.05	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	1	2010-0527-OV005	OV005	28.802306	-88.366047	05.28.2010	MAY 28 2010	1001	7126.74	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	1	2010-0527-OV006	OV006	28.717278	-88.385283	05.28.2010	MAY 28 2010	1399	2992.18	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	1	2010-0527-OV007	OV007	28.807528	-87.969964	05.28.2010	MAY 28 2010	1848	39518.07	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	1	2010-0527-OV008	OV008	28.679986	-87.967217	05.28.2010	MAY 28 2010	1998	39582.55	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	2	2010-0603-TJ03	TJ03	28.691500	-88.445200	05.28.2010	MAY 28 2010	1210	9329.84	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	2	2010-0603-TJ04	TJ04	28.672833	-88.463660	05.28.2010	MAY 28 2010	129	12006.35	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	2	2010-0603-TJ06	TJ06	28.646000	-88.477160	05.28.2010	MAY 28 2010	1191	14944.33	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	2	2010-0603-TJ07	TJ07	28.696666	-88.514660	05.28.2010	MAY 28 2010	1204	15270.84	-99	-99	-99	-99	-99	-99	-99
Walton Smith	1	2010_0527_WS16A	WS016	28.697167	-88.560000	05.28.2010	MAY 28 2010	1313	19535.40	4.02	3.27	0.33	0.41	2.27	0.66	122.3
Walton Smith	1	2010_0528_WS17A	WS017	28.692167	-88.577667	05.28.2010	MAY 28 2010	1142	21347.46	-99	-99	-99	-99	-99	-99	-99
Walton Smith	1	2010_0528_WS18A	WS018	28.689833	-88.595000	05.28.2010	MAY 28 2010	1073	23057.70	-99	-99	-99	-99	-99	-99	-99
Walton Smith	1	2010_0528_WS19A	WS019	28.685833	-88.614167	05.28.2010	MAY 28 2010	1057	24986.22	-99	-99	-99	-99	-99	-99	-99
Walton Smith	1	2010_0528_WS20A	WS020	28.680500	-88.631833	05.28.2010	MAY 28 2010	1073	26807.10	-99	-99	-99	-99	-99	-99	-99
Walton Smith	1	2010_0528_WS21A	WS021	28.675667	-88.651000	05.28.2010	MAY 28 2010	1077	28757.92	-99	-99	-99	-99	-99	-99	-99
Walton Smith	1	2010_0528_WS22A	WS022	28.672000	-88.668833	05.28.2010	MAY 28 2010	1113	30550.80	-99	-99	-99	-99	-99	-99	-99
Walton Smith	1	2010_0528_WS23A	WS023	28.668500	-88.687833	05.28.2010	MAY 28 2010	1236	32450.17	-99	-99	-99	-99	-99	-99	-99
Walton Smith	1	2010_0528_WS24A	WS024	28.684167	-88.687167	05.28.2010	MAY 28 2010	1147	32013.67	-99	-99	-99	-99	-99	-99	-99
Walton Smith	1	2010_0528_WS25A	WS025	28.693000	-88.657500	05.28.2010	MAY 28 2010	993	28979.31	-99	-99	-99	-99	-99	-99	-99
Walton Smith	1	2010_0528_WS26A	WS026	28.709167	-88.582167	05.28.2010	MAY 28 2010	978	21409.92	-99	-99	-99	-99	-99	-99	-99
Walton Smith	1	2010_0528_WS27A	WS027	28.712333	-88.565000	05.28.2010	MAY 28 2010	1155	19695.73	-99	-99	-99	-99	-99	-99	-99
Walton Smith	1	2010_0528_WS28A	WS028	28.721000	-88.525667	05.28.2010	MAY 28 2010	1174	15750.76	-99	-99	-99	-99	-99	-99	-99
Walton Smith	1	2010_0528_WS29A	WS029	28.726833	-88.489000	05.28.2010	MAY 28 2010	1360	12111.15	4.1	3.15	0.29	0.21	2.09	0.4	63.99
Walton Smith	1	2010_0530_WS30A	WS030	28.762667	-88.386000	05.28.2010	MAY 28 2010	1395	3357.65	-99	-99	-99	-99	-99	-99	-99
Walton Smith	1	2010_0530_WS31A	WS031	28.766833	-88.347000	05.28.2010	MAY 28 2010	1475	3687.16	-99	-99	-99	-99	-99	-99	-99
Walton Smith	1	2010_0530_WS32A	WS032	28.739500	-88.326667	05.28.2010	MAY 28 2010	1541	3848.07	4.17	3.78	0.21	-99	-99	-99	-99
Walton Smith	1	2010_0530_WS33A	WS033	28.709500	-88.348167	05.28.2010	MAY 28 2010	1583	3626.10	4.15	3.8	0.19	-99	-99	-99	-99
Walton Smith	1	2010_0530_WS34A	WS034	28.712167	-88.387500	05.28.2010	MAY 28 2010	1578	3574.22	4.13	3.82	0.17	4.3	17.92	5.68	1293.79
Walton Smith	1	2010_0530_WS34B	WS034	28.712000	-88.386500	05.28.2010	MAY 28 2010	1586	3532.50	4.09	3.74	0.19	5.3	25.88	8.06	1596.56
Walton Smith	1	2010_0530_WS35A	WS035	28.690833	-88.405167	05.28.2010	MAY 28 2010	1518	6507.93	4.18	3.82	0.19	0	0.04	0	0.08
Gordon Gunter	1		002-H	28.931833	-88.745833	05.29.2010	MAY 29 2010	359	42923.67	-99	-99	-99	-99	-99	-99	-99
Gordon Gunter	1	2010_0529_003	003-H	29.004667	-87.948500	5.29.2010	MAY 29 2010	1448	50429.61	4.5	4.09	0.2	0.01	0.15	0.03	4.31
Gordon Gunter	1	2010_0529_004	004-H	28.896000	-88.017333	5.29.2010	MAY 29 2010	1651	38351.31	4.39	4.05	0.2	0	0.04	0	0.29
Jack Fitz	2		JF009-C2	28.708167	-88.387667	05.29.2010	MAY 29 2010	1592	3950.30	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	1	2010-0527-OV009	OV009	28.740994	-88.168814	05.29.2010	MAY 29 2010	1693	19301.95	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	1	2010-0527-OV010	OV010	28.730275	-88.416872	05.29.2010	MAY 29 2010	1184	5061.32	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	1	2010-0527-OV011	OV011	28.732011	-88.376789	05.29.2010	MAY 29 2010	1295	1261.03	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	1	2010-0527-OV012	OV012	28.735442	-88.557581	05.29.2010	MAY 29 2010	802	18760.23	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	2	2010-0603-TJ08	TJ08	28.704700	-88.508830	05.29.2010	MAY 29 2010	1214	14472.97	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	2	2010-0603-TJ09	TJ09	28.707500	-88.533166	05.29.2010	MAY 29 2010	1148	16720.34	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	2	2010-0603-TJ10	TJ10	28.708500	-88.537700	05.29.2010	MAY 29 2010	1208	17133.35	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	5	2010-0530-B53	BM53	28.735083	-88.381880	05.30.2010	MAY 30 2010	1509	1596.41	4.39	3.85	0.2	12.22	38.03	12.91	3675.01
Brooks McCall	5	2010-0530-B54	BM54	28.732017	-88.376688	05.30.2010	MAY 30 2010	1530	1252.42	4.32	3.48	0.23	7.71	31.62	8.69	2318.7
Brooks McCall	5	2010-0530-B55	BM55	28.758013	-88.387893	05.30.2010	MAY 30 2010	1325	3080.08	4.37	4	0.21	0	0.09	0.01	0.21
Gordon Gunter	1		005-H	29.097833	-88.397667	5.30.2010	MAY 30 2010	354	40070.35	-99	-99	-99	-99	-99	-99	-99
Gordon Gunter	1	2010_0530_006	006-H	28.906333	-87.981667	5.30.2010	MAY 30 2010	1606	41982.59	4.44	4.03	0.22	0.02	0.14	0.03	5.24

Appendix 5: QA / QC JAG Oxygen Data

Vessel	CruiseID	StationID	StationName	StationLat	StationLon	SampleDate	DateString	DepthOfCast	Dist2Wellhead	DO2_MEAN	DO2_MIN	DO2_SDEV	CDOM_MEAN	CDOM_MAX	CDOM_SDEV	CDOM_INT
Gordon Gunter	1	2010_0530_007	007-H	29.025000	-88.128500	5.30.2010	MAY 30 2010	1077	39425.14	-99	-99	-99	-99	-99	-99	-99
Gordon Gunter	1	2010_0530_008	008-H	28.802833	-88.229167	5.30.2010	MAY 30 2010	1279	15193.08	-99	-99	-99	-99	-99	-99	-99
Jack Fitz	2		JF010-C2	28.723833	-88.377000	05.30.2010	MAY 30 2010	260	1922.53	-99	-99	-99	-99	-99	-99	-99
Walton Smith	1	2010_0530_WS36A	WS036	28.710167	-88.408833	05.30.2010	MAY 30 2010	1549	5223.30	4.12	3.83	0.18	2.67	11.69	3.66	804.2
Walton Smith	1	2010_0530_WS37A	WS037	28.709333	-88.437333	05.30.2010	MAY 30 2010	1401	7686.47	4.16	3.81	0.18	1.1	6.96	1.29	331.73
Walton Smith	1	2010_0530_WS38A	WS038	28.712333	-88.397167	05.30.2010	MAY 30 2010	1544	4190.27	4.15	3.72	0.19	1.71	10.14	2.51	514.86
Walton Smith	1	2010_0530_WS39A	WS039	28.703167	-88.474167	05.30.2010	MAY 30 2010	1307	11284.65	4.14	3.71	0.22	0.46	5.2	1.04	139.37
Walton Smith	1	2010_0530_WS40A	WS040	28.687833	-88.534500	05.30.2010	MAY 30 2010	1403	17422.63	4.12	3.79	0.17	0.22	1.07	0.31	67.22
Walton Smith	1	2010_0530_WS41A	WS041	28.681333	-88.571333	05.30.2010	MAY 30 2010	1319	21075.37	4.07	3.73	0.17	0.06	0.49	0.1	18.61
Walton Smith	1	2010_0530_WS42A	WS042	28.672833	-88.618167	05.30.2010	MAY 30 2010	1140	25737.66	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	5	2010-0530-B56	BM56	28.723547	-88.414878	05.31.2010	MAY 31 2010	1530	5057.11	4.37	3.93	0.21	0.01	0.19	0.03	3.46
Brooks McCall	5	2010-0530-B57	BM57	28.705093	-88.401650	05.31.2010	MAY 31 2010	1500	5068.67	4.22	3.69	0.22	4.65	20.74	6.27	1400.67
Brooks McCall	5	2010-0530-B58	BM58	28.672323	-88.435935	05.31.2010	MAY 31 2010	1299	10020.05	4.36	3.68	0.24	0.8	15.77	2.66	239.59
Brooks McCall	5	2010-0530-B59	BM59	28.638928	-88.471285	05.31.2010	MAY 31 2010	1400	15094.08	4.4	4.03	0.2	0	0.07	0.01	0.36
Gordon Gunter	1	2010_0531_009	009-H	28.653833	-88.345667	5.31.2010	MAY 31 2010	1725	9572.11	4.41	4.07	0.2	0	0.09	0.01	0.85
Gordon Gunter	1	2010_0531_010	010-H	28.850000	-88.264500	5.31.2010	MAY 31 2010	1159	15902.77	-99	-99	-99	-99	-99	-99	-99
Jack Fitz	2		JF011-C2	28.760333	-88.357167	05.31.2010	MAY 31 2010	1477	2610.45	-99	-99	-99	-99	-99	-99	-99
Walton Smith	1	2010_0531_WS43A	WS043	28.650000	-88.617167	05.31.2010	MAY 31 2010	1307	26475.33	4.04	3.28	0.26	0.33	15.24	1.02	98.19
Walton Smith	1	2010_0531_WS44A	WS044	28.629500	-88.545333	05.31.2010	MAY 31 2010	1567	21312.03	4.17	3.88	0.16	0	0.07	0.01	0.35
Walton Smith	1	2010_0531_WS45A	WS045	28.683667	-88.465333	05.31.2010	MAY 31 2010	1323	11458.56	4.19	3.88	0.18	0	0.14	0.02	1.3
Walton Smith	1	2010_0531_WS46A	WS046	28.694833	-88.433500	05.31.2010	MAY 31 2010	1338	8178.09	3.99	3.52	0.25	3.07	12.29	3.3	924.44
Walton Smith	1	2010_0531_WS46B	WS046	28.693833	-88.432500	05.31.2010	MAY 31 2010	1322	8165.59	-99	-99	-99	-99	-99	-99	-99
Walton Smith	1	2010_0531_WS47A	WS047	28.720833	-88.397333	05.31.2010	MAY 31 2010	1550	3624.50	3.97	3.32	0.22	7.41	30.17	8.89	2230.24
Walton Smith	1	2010_0531_WS48A	WS048	28.732333	-88.401167	05.31.2010	MAY 31 2010	1520	3507.70	3.98	3.17	0.37	1.47	5.65	1.63	441.02
Walton Smith	1	2010_0531_WS49A	WS049	28.722500	-88.387833	05.31.2010	MAY 31 2010	1570	2758.44	4.14	3.79	0.19	0.18	1.04	0.27	55.01
Walton Smith	1	2010_0531_WS50A	WS050	28.716333	-88.378333	05.31.2010	MAY 31 2010	1584	2708.68	4.13	3.79	0.2	0	0.07	0.01	0.39
Walton Smith	1	2010_0531_WS51A	WS051	28.721500	-88.381000	05.31.2010	MAY 31 2010	1543	2363.86	4.14	3.79	0.2	0	0.08	0.01	0.24
Brooks McCall	5	2010-0530-B60	BM60	28.725908	-88.372033	06.01.2010	JUN 01 2010	1498	1483.52	4.42	4.04	0.2	0	0.01	0	0.01
Brooks McCall	5	2010-0530-B61	BM61	28.696512	-88.384982	06.01.2010	JUN 01 2010	1400	4985.05	4.41	4.05	0.21	0	0.05	0	0.19
Brooks McCall	5	2010-0530-B62	BM62	28.654526	-88.404116	06.01.2010	JUN 01 2010	1400	10010.65	4.43	4.05	0.23	0	0.04	0	0.16
Brooks McCall	5	2010-0530-B63	BM63	28.663980	-88.421060	06.01.2010	JUN 01 2010	1341	9847.22	4.44	4.06	0.24	0.01	0.38	0.04	2.68
Brooks McCall	5	2010-0530-B64	BM64	28.683393	-88.448712	06.01.2010	JUN 01 2010	1368	10131.31	4.43	3.55	0.24	0.12	2.68	0.42	36.35
Gordon Gunter	1		011-H	28.849167	-88.260883	6.01.2010	JUN 01 2010	660	16054.91	-99	-99	-99	-99	-99	-99	-99
Gordon Gunter	1	2010_0601_012	012-H	28.817167	-88.432833	6.01.2010	JUN 01 2010	1218	10948.70	-99	-99	-99	-99	-99	-99	-99
Gordon Gunter	1	2010_0601_013	013-H	28.794667	-88.452167	6.01.2010	JUN 01 2010	1317	10517.07	4.47	4.05	0.13	0	0.09	0.01	0.3
Gordon Gunter	1	2010_0601_014	014-H	28.771167	-88.481833	06.01.2010	JUN 01 2010	1340	11920.30	4.51	4.24	0.14	0	0.08	0.01	0.21
Gordon Gunter	1	2010_0601_015	015-H	28.739833	-88.484667	6.01.2010	JUN 01 2010	1401	11622.54	4.5	4.15	0.19	0	0.05	0	0.11
Gordon Gunter	1	2010_0601_016	016-H	28.704333	-88.481667	06.01.2010	JUN 01 2010	1332	11935.26	4.46	4.05	0.21	0.01	0.28	0.04	4.07
Gordon Gunter	1	2010_0601_017	017-H	28.680500	-88.453667	6.01.2010	JUN 01 2010	1383	10712.36	4.41	4.01	0.22	0.59	3.84	0.85	176.67
Gordon Gunter	1	2010_0601_018	018-H	28.655333	-88.424833	6.01.2010	JUN 01 2010	1311	10855.27	4.47	4.1	0.21	0	0.08	0.01	0.84
Walton Smith	2	2010_0603_WS52A	WS052	28.721167	-88.364667	06.01.2010	JUN 01 2010	1567	1889.34	4.12	3.76	0.21	0	0.1	0.01	0.16
Walton Smith	2	2010_0603_WS53A	WS053	28.733333	-88.384333	06.01.2010	JUN 01 2010	1509	1877.56	4.13	3.78	0.21	5.03	28.68	8.3	1512.41
Walton Smith	2	2010_0603_WS54A	WS054	28.728500	-88.393500	06.01.2010	JUN 01 2010	1531	2902.18	4.13	3.77	0.2	1.84	22.26	4.71	554.21
Walton Smith	2	2010_0603_WS55A	WS055	28.719167	-88.406167	06.01.2010	JUN 01 2010	1511	4466.02	4.15	3.66	0.19	0.26	1.81	0.39	78.13
Walton Smith	2	2010_0603_WS56A	WS056	28.715333	-88.393667	06.01.2010	JUN 01 2010	1418	3712.39	4.16	3.8	0.19	0	0.07	0.01	0.25
Walton Smith	2	2010_0603_WS57A	WS057	28.736167	-88.394833	06.01.2010	JUN 01 2010	1487	2836.36	4.13	3.46	0.25	1.13	13.48	2.16	338.86
Walton Smith	2	2010_0603_WS58A	WS058	28.737167	-88.382833	06.01.2010	JUN 01 2010	1489	1656.72	4.07	3.23	0.37	6.8	20.22	6.05	2046.99
Walton Smith	2	2010_0604_WS58B	WS058	28.737500	-88.385667	06.01.2010	JUN 01 2010	1492	1931.85	4.11	3.74	0.19	0.26	3.15	0.75	79.48
Walton Smith	2	2010_0603_WS59A	WS059	28.737167	-88.379833	06.01.2010	JUN 01 2010	1505	1363.81	4.1	3.29	0.32	3.29	17.18	4.01	989.56
Gordon Gunter	1	2010_0602_019	019-H	28.667167	-88.466833	6.02.2010	JUN 02 2010	1382	12638.17	4.25	3.66	0.3	2.39	12.63	3.54	720.65
Gordon Gunter	1	2010_0602_020	020-H	28.662667	-88.476500	6.02.2010	JUN 02 2010	1403	13691.37	4.27	3.69	0.25	2.3	13.03	3.48	690.87

Appendix 5: QA / QC JAG Oxygen Data

Vessel	CruiseID	StationID	StationName	StationLat	StationLon	SampleDate	DateString	DepthOfCast	Dist2Wellhead	DO2_MEAN	DO2_MIN	DO2_SDEV	CDOM_MEAN	CDOM_MAX	CDOM_SDEV	CDOM_INT
Gordon Gunter	1	2010_0602_021	021-H	28.553333	-88.491333	6.02.2010	JUN 02 2010	1692	23919.89	4.47	4.14	0.17	0	0.12	0.01	1.18
Gordon Gunter	1	2010_0602_022	022-H	28.647500	-88.532833	6.02.2010	JUN 02 2010	1532	19193.91	4.46	4.15	0.17	0	0.14	0.02	1.46
Gordon Gunter	1	2010_0602_023	023-H	28.652167	-88.385667	6.02.2010	JUN 02 2010	1563	9742.04	4.41	4.04	0.22	0	0.1	0.01	0.95
Gordon Gunter	1	2010_0602_024	024-H	28.653833	-88.353167	6.02.2010	JUN 02 2010	1707	9447.05	4.41	4.04	0.22	0	0.11	0.01	0.64
Gordon Gunter	1	2010_0602_025	025-H	28.678000	-88.320333	6.02.2010	JUN 02 2010	1466	8035.44	4.44	4.07	0.19	0	0.1	0.01	0.24
Ocean Veritas	2	2010-0527-OV013	OV013	28.801976	-88.391856	06.02.2010	JUN 02 2010	1162	7529.81	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	2	2010-0527-OV015	OV015	28.740080	-88.391591	06.02.2010	JUN 02 2010	1443	2519.67	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	2	2010-0527-OV016	OV016	28.740080	-88.391591	06.02.2010	JUN 02 2010	1202	2519.67	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	2	2010-0603-TJ11	TJ11	28.720167	-88.450330	06.02.2010	JUN 02 2010	1206	8498.64	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	2	2010-0603-TJ12	TJ12	28.697030	-88.509150	06.02.2010	JUN 02 2010	1206	14744.87	-99	-99	-99	-99	-99	-99	-99
Gordon Gunter	1	2010_0603_026	026-H	28.702833	-88.273167	6.03.2010	JUN 03 2010	1493	9894.56	4.44	4.07	0.19	0.01	0.13	0.02	2.15
Gordon Gunter	1	2010_0603_027	027-H	28.700667	-88.337667	6.03.2010	JUN 03 2010	1463	4998.90	4.41	3.73	0.23	0	0.25	0.02	0.37
Gordon Gunter	1	2010_0603_028	028-H	28.706167	-88.453000	6.03.2010	JUN 03 2010	1272	9232.99	-99	-99	-99	-99	-99	-99	-99
Gordon Gunter	1	2010_0603_029	029-H	28.693500	-88.435167	6.03.2010	JUN 03 2010	1301	8397.25	4.44	4.1	0.22	0	0.14	0.01	0.68
Walton Smith	2	2010_0604_WS60A	WS060	28.740833	-88.384667	06.03.2010	JUN 03 2010	1482	1856.88	4.1	3.79	0.21	1.58	9.11	2.7	475.66
Gordon Gunter	1	2010_0604_030	030-H	28.678167	-88.425000	6.04.2010	JUN 04 2010	1347	8820.61	4.42	4.05	0.22	0.01	0.15	0.03	3.07
Ocean Veritas	2	2010-0527-OV021	OV021	28.706500	-88.347900	06.04.2010	JUN 04 2010	1502	3933.33	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	2		OV022	28.706500	-88.347900	06.04.2010	JUN 04 2010	6	3933.33	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	2	2010-0527-OV023	OV023	28.674600	-88.329800	06.04.2010	JUN 04 2010	1505	7895.19	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	2	2010-0527-OV024	OV024	28.675768	-88.347224	06.04.2010	JUN 04 2010	1618	7166.01	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	2	2010-0527-OV025	OV025	28.689414	-88.361276	06.04.2010	JUN 04 2010	1600	5431.16	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	2	2010-0527-OV026	OV026	28.707290	-88.360949	06.04.2010	JUN 04 2010	1576	3461.18	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	2	2010-0603-TJ14	TJ14	29.316660	-88.187500	06.04.2010	JUN 04 2010	85	66582.50	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	2	2010-0603-TJ15	TJ15	28.879666	-89.175833	06.04.2010	JUN 04 2010	89	80738.05	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ16	28.537333	-90.191230	06.04.2010	JUN 04 2010	42	180078.42	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ17	28.242983	-90.317067	06.04.2010	JUN 04 2010	92	199004.58	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ18	28.137833	-90.327333	06.04.2010	JUN 04 2010	192	203575.99	-99	-99	-99	-99	-99	-99	-99
Walton Smith	2	2010_0604_WS06B	WS006	28.726333	-88.423500	06.04.2010	JUN 04 2010	1454	5784.85	4.02	3.66	0.25	2.04	16.17	4.18	613.99
Walton Smith	2	2010_0604_WS08B	WS008	28.726000	-88.435667	06.04.2010	JUN 04 2010	1466	6957.18	4.1	3.6	0.21	0.15	1.37	0.27	44.45
Walton Smith	2	2010_0604_WS61A	WS061	28.748333	-88.397167	06.04.2010	JUN 04 2010	1419	3259.07	4.16	3.76	0.18	0.1	3.34	0.45	30.37
Walton Smith	2	2010_0604_WS62A	WS062	28.743333	-88.462000	06.04.2010	JUN 04 2010	1426	9419.90	4.16	3.59	0.21	0.09	0.89	0.18	27.9
Walton Smith	2	2010_0604_WS63A	WS063	28.733833	-88.533500	06.04.2010	JUN 04 2010	1119	16408.03	-99	-99	-99	-99	-99	-99	-99
Walton Smith	2	2010_0604_WS64A	WS064	28.718000	-88.601833	06.04.2010	JUN 04 2010	959	23198.79	-99	-99	-99	-99	-99	-99	-99
Walton Smith	2	2010_0604_WS66A	WS066	28.672667	-88.529167	06.04.2010	JUN 04 2010	1436	17558.00	4.18	3.62	0.19	0.02	0.28	0.05	5.89
Walton Smith	2	2010_0604_WS67A	WS067	28.742667	-88.433500	06.04.2010	JUN 04 2010	1463	6631.74	4.15	3.75	0.18	0	0.07	0.01	0.48
Brooks McCall	6	2010_0605_B65	BM65	28.732025	-88.376726	06.05.2010	JUN 05 2010	1542	1255.02	4.36	3.91	0.21	0	0.26	0.01	0.26
Brooks McCall	6	2010_0605_B66	BM66	28.729575	-88.366420	06.05.2010	JUN 05 2010	1559	952.43	4.36	3.98	0.2	0.12	2.74	0.39	35.84
Brooks McCall	6	2010_0605_B67	BM67	28.693435	-88.366676	06.05.2010	JUN 05 2010	1595	4965.78	4.33	3.89	0.24	0.2	1.86	0.43	61.16
Walton Smith	2	2010_0605_WS47B	WS047	28.720167	-88.395667	06.05.2010	JUN 05 2010	1519	3528.61	4.12	3.71	0.2	0.01	0.21	0.04	3.86
Walton Smith	2	2010_0605_WS53B	WS053	28.733167	-88.383667	06.05.2010	JUN 05 2010	1487	1820.62	4.12	3.67	0.19	0.18	4.64	0.68	54.56
Walton Smith	2	2010_0605_WS59B	WS059	28.740000	-88.378500	06.05.2010	JUN 05 2010	1486	1246.22	4.13	3.63	0.2	0	0.05	0	0.21
Walton Smith	2	2010_0605_WS68B	WS068	28.749833	-88.379167	06.05.2010	JUN 05 2010	1444	1833.48	4.16	3.68	0.18	0	0.1	0.01	0.28
Walton Smith	2	2010_0605_WS69A	WS069	28.755333	-88.369000	06.05.2010	JUN 05 2010	1423	1932.89	4.16	3.79	0.17	0	0.02	0	0.03
Walton Smith	2	2010_0605_WS70A	WS070	28.752833	-88.355000	06.05.2010	JUN 05 2010	1468	1952.22	4.17	3.76	0.17	0	0.08	0.01	0.21
Walton Smith	2	2010_0605_WS71C	WS071	28.744167	-88.346167	06.05.2010	JUN 05 2010	1518	2048.57	4.18	3.74	0.19	0	0.03	0	0.13
Walton Smith	2	2010_0605_WS72A	WS072	28.732167	-88.348500	06.05.2010	JUN 05 2010	1550	1832.15	4.15	3.75	0.21	0	0.15	0.01	0.36
Walton Smith	2	2010_0605_WS73A	WS073	28.722333	-88.357000	06.05.2010	JUN 05 2010	1562	1961.91	4.16	3.75	0.19	0.15	2.59	0.36	46.09
Walton Smith	2	2010_0605_WS75A	WS075	28.726167	-88.382500	06.05.2010	JUN 05 2010	1542	2096.42	4.13	3.61	0.21	2.06	8.91	2.74	620.19
Walton Smith	2	2010_0605_WS76A	WS076	28.727000	-88.377333	06.05.2010	JUN 05 2010	1545	1665.46	4.11	3.69	0.19	0.18	3.65	0.48	53.8
Walton Smith	2	2010_0605_WS77A	WS077	28.728333	-88.385167	06.05.2010	JUN 05 2010	1536	2174.18	4.11	3.76	0.19	0.01	0.18	0.03	1.94

Appendix 5: QA / QC JAG Oxygen Data

Vessel	CruiseID	StationID	StationName	StationLat	StationLon	SampleDate	DateString	DepthOfCast	Dist2Wellhead	DO2_MEAN	DO2_MIN	DO2_SDEV	CDOM_MEAN	CDOM_MAX	CDOM_SDEV	CDOM_INT
Walton Smith	2	2010_0605_WS78A	WS078	28.774500	-88.521000	06.05.2010	JUN 05 2010	1164	15702.74	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	6	2010_0606_B68	BM68	28.648186	-88.366673	06.06.2010	JUN 06 2010	1590	9991.18	4.33	3.82	0.22	0	0.15	0.01	0.9
Brooks McCall	6	2010_0606_B69	BM69	28.697133	-88.346713	06.06.2010	JUN 06 2010	1537	4928.51	4.34	3.75	0.24	0	0.19	0.02	0.84
Brooks McCall	6	2010_0606_B70	BM70	28.706515	-88.330276	06.06.2010	JUN 06 2010	1469	4953.23	4.36	3.99	0.2	0	0.09	0.01	0.92
Walton Smith	2	2010_0605_WS16B	WS016	28.698000	-88.555667	06.06.2010	JUN 06 2010	1382	19101.25	4.14	3.61	0.21	0.14	0.58	0.14	41.27
Walton Smith	2	2010_0606_WS79A	WS079	28.851000	-88.489000	06.06.2010	JUN 06 2010	899	17379.29	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	6	2010_0607_B72	BM72	28.748163	-88.377422	06.07.2010	JUN 07 2010	1457	1581.53	4.39	3.81	0.21	0.01	0.15	0.02	3.18
Brooks McCall	6	2010_0607_B73	BM73	28.722980	-88.373478	06.07.2010	JUN 07 2010	1575	1838.20	4.39	3.84	0.2	0	0	0	0
Brooks McCall	6	2010_0607_B74	BM74	28.688098	-88.418302	06.07.2010	JUN 07 2010	1411	7561.00	4.38	3.93	0.24	0.16	3.36	0.56	47.24
Ocean Veritas	3	2010-0608-OV027	OV027	28.800795	-88.504048	06.08.2010	JUN 08 2010	1084	15200.30	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	3	2010-0608-OV028	OV028	28.800750	-88.462457	06.08.2010	JUN 08 2010	1230	11728.11	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	3	2010-0608-OV029	OV029	28.774282	-88.462457	06.08.2010	JUN 08 2010	1336	10263.08	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	3	2010-0608-OV030	OV030	28.670523	-88.391623	06.08.2010	JUN 08 2010	1511	7919.68	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ19	27.974660	-90.318000	06.08.2010	JUN 08 2010	492	209494.33	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ20	28.085983	-91.798600	06.08.2010	JUN 08 2010	91	344260.38	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ21	27.884350	-91.777500	06.08.2010	JUN 08 2010	197	347955.82	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ22	27.759333	-91.791666	06.08.2010	JUN 08 2010	491	353488.21	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	3	2010-0608-OV031	OV031	28.715668	-88.366609	06.09.2010	JUN 09 2010	1564	2496.75	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	3	2010-0608-OV032	OV032	28.715530	-88.361426	06.09.2010	JUN 09 2010	1564	2549.92	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	3	2010-0608-OV033	OV033	28.715869	-88.371690	06.09.2010	JUN 09 2010	1562	2536.71	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	3	2010-0608-OV034	OV034	28.718224	-88.376945	06.09.2010	JUN 09 2010	1558	2460.21	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	3	2010-0608-OV035	OV035	28.723998	-88.384983	06.09.2010	JUN 09 2010	1486	2437.34	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ24	27.128267	-93.398500	06.09.2010	JUN 09 2010	827	526602.42	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ25	28.535167	-93.642833	06.09.2010	JUN 09 2010	36	516586.36	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ26	28.038056	-93.728333	06.09.2010	JUN 09 2010	93	531375.52	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ27	27.925167	-93.534167	06.09.2010	JUN 09 2010	112	514874.97	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ28	27.906150	-93.694740	06.09.2010	JUN 09 2010	102	530782.57	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	3	2010-0608-OV036	OV036	28.732010	-88.376790	06.10.2010	JUN 10 2010	1522	1261.19	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	3	2010-0608-OV039	OV039	28.745000	-88.398000	06.10.2010	JUN 10 2010	1415	3228.91	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	3	2010-0608-OV040	OV040	28.745000	-88.422000	06.10.2010	JUN 10 2010	1440	5539.58	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ29	27.776170	-93.669710	06.10.2010	JUN 10 2010	170	531378.79	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ30	28.001730	-93.279880	06.10.2010	JUN 10 2010	67	488701.95	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ31	27.968890	-92.720890	06.10.2010	JUN 10 2010	126	435570.41	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	7	2010_0611_B75	BM75	28.723622	-88.414820	06.11.2010	JUN 11 2010	1531	5049.02	4.4	4.05	0.18	0	0.08	0.01	0.48
Brooks McCall	7	2010_0611_B76	BM76	28.732355	-88.417212	06.11.2010	JUN 11 2010	1512	5059.54	4.39	4.07	0.19	0.1	1.62	0.27	30.82
Brooks McCall	7	2010_0611_B77	BM77	28.741417	-88.417597	06.11.2010	JUN 11 2010	1483	5069.13	4.42	4.07	0.18	0.31	4.32	0.9	91.83
Brooks McCall	7	2010_0611_B78	BM78	28.750397	-88.415992	06.11.2010	JUN 11 2010	1433	5084.37	4.42	4.13	0.17	0.14	2.02	0.45	41.79
Brooks McCall	7	2010_0612_B79	BM79	28.758767	-88.412258	06.12.2010	JUN 12 2010	1402	5079.08	4.4	4.08	0.19	0.02	0.71	0.1	6.35
Brooks McCall	7	2010_0612_B80	BM80	28.748740	-88.389343	06.12.2010	JUN 12 2010	1441	2575.17	4.43	4.05	0.18	0.07	1.51	0.28	21.3
Brooks McCall	7	2010_0612_B81	BM81	28.735495	-88.391867	06.12.2010	JUN 12 2010	1502	2554.46	4.44	4.1	0.18	0.19	1.92	0.46	56.15
Brooks McCall	7	2010_0612_B82	BM82	28.739988	-88.376563	06.12.2010	JUN 12 2010	1496	1059.44	4.44	3.98	0.19	0.09	0.87	0.2	26.29
Jack Fitz	3		JF001-C3	28.273167	-88.917000	06.12.2010	JUN 12 2010	1315	74742.68	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	7	2010_0613_B83	BM83	28.747703	-88.427198	06.13.2010	JUN 13 2010	1436	6089.00	4.44	4.04	0.22	0.05	0.57	0.11	15.11
Brooks McCall	7	2010_0613_B84	BM84	28.766427	-88.406815	06.13.2010	JUN 13 2010	1387	5086.42	4.43	3.84	0.2	0.15	1.71	0.32	45.52
Brooks McCall	7	2010_0613_B85	BM85	28.772935	-88.399692	06.13.2010	JUN 13 2010	1378	5083.68	4.42	3.78	0.21	0.18	1.55	0.36	55.5
Brooks McCall	7	2010_0613_B86	BM86	28.778045	-88.391320	06.13.2010	JUN 13 2010	1370	5080.46	4.4	3.8	0.21	0.13	1.71	0.31	40.14
Brooks McCall	7	2010_0613_B87	BM87	28.781590	-88.381860	06.13.2010	JUN 13 2010	1374	5070.99	4.39	3.83	0.21	0.11	1.63	0.29	33.9
Jack Fitz	3		JF002-C3	28.739167	-88.387167	06.13.2010	JUN 13 2010	1497	2080.49	-99	-99	-99	-99	-99	-99	-99
Jack Fitz	3		JF003-C3	28.748500	-88.366833	06.14.2010	JUN 14 2010	1487	1153.94	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	4	2010-0608-OV042	OV042	28.791880	-88.338926	06.14.2010	JUN 14 2010	1302	6528.39	4.5	4.12	0.2	0.06	0.69	0.12	18.96
Ocean Veritas	4	2010-0608-OV043	OV043	28.762861	-88.353747	06.14.2010	JUN 14 2010	1450	2994.09	4.44	4	0.23	0.59	3.77	0.84	178.53
Ocean Veritas	4	2010-0608-OV044	OV044	28.752616	-88.340081	06.14.2010	JUN 14 2010	1502	2999.16	4.42	3.88	0.25	0.38	2.8	0.59	115.76
Ocean Veritas	4	2010-0608-OV045	OV045	28.763623	-88.323622	06.14.2010	JUN 14 2010	1299	5017.27	4.47	4	0.21	0.24	2.31	0.57	72.56

Appendix 5: QA / QC JAG Oxygen Data

Vessel	CruiseID	StationID	StationName	StationLat	StationLon	SampleDate	DateString	DepthOfCast	Dist2Wellhead	DO2_MEAN	DO2_MIN	DO2_SDEV	CDOM_MEAN	CDOM_MAX	CDOM_SDEV	CDOM_INT
Ocean Veritas	4	2010-0608-OV046	OV046	28.751052	-88.316943	06.14.2010	JUN 14 2010	1438	5006.55	4.45	4.01	0.22	0.19	1.96	0.36	58.04
Thomas Jefferson	3		TJ32	27.918860	-92.643150	06.14.2010	JUN 14 2010	299	429338.53	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ33	27.892730	-91.631970	06.14.2010	JUN 14 2010	310	333975.27	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ34	27.915700	-91.199600	06.14.2010	JUN 14 2010	216	292698.15	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ35	27.920000	-91.308000	06.14.2010	JUN 14 2010	312	302665.65	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ36	28.079000	-91.087900	06.14.2010	JUN 14 2010	110	276793.95	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	4	2010-0608-OV047	OV047	28.741417	-88.417597	06.15.2010	JUN 15 2010	1461	5069.13	4.52	3.97	0.23	0	0.12	0.01	0.44
Ocean Veritas	4	2010-0608-OV048	OV048	28.732010	-88.376790	06.15.2010	JUN 15 2010	1520	1261.19	4.54	4.13	0.19	0	0.17	0.02	1.37
Ocean Veritas	4	2010-0608-OV049	OV049	28.780754	-88.387846	06.15.2010	JUN 15 2010	1346	5195.72	4.51	3.83	0.26	0.04	0.71	0.11	13.36
Ocean Veritas	4	2010-0608-OV050	OV050	28.780347	-88.347809	06.15.2010	JUN 15 2010	1427	5012.69	4.52	3.98	0.18	0.14	1.94	0.33	42.47
Ocean Veritas	4	2010-0608-OV051	OV051	28.754515	-88.357993	06.15.2010	JUN 15 2010	1455	1978.32	4.55	4.16	0.18	0.18	2.66	0.45	54.04
Thomas Jefferson	3		TJ37	28.387660	-90.846370	06.15.2010	JUN 15 2010	41	246033.92	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ38	28.482100	-90.488100	06.15.2010	JUN 15 2010	34	209720.39	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ39	28.715700	-90.275500	06.15.2010	JUN 15 2010	27	186796.01	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ40	28.862470	-90.155990	06.15.2010	JUN 15 2010	21	175518.73	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ41	28.632590	-89.964810	06.15.2010	JUN 15 2010	252	156910.00	-99	-99	-99	-99	-99	-99	-99
Jack Fitz	3		JF004-C3	28.757167	-88.365167	06.16.2010	JUN 16 2010	1059	2114.62	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	4	2010-0608-OV052	OV052	28.754902	-88.291345	06.16.2010	JUN 16 2010	1284	7536.05	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	4	2010-0608-OV053	OV053	28.779023	-88.305090	06.16.2010	JUN 16 2010	1236	7489.80	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	4	2010-0608-OV054	OV054	28.798055	-88.330431	06.16.2010	JUN 16 2010	1208	7507.72	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	4	2010-0608-OV055	OV055	28.806069	-88.365333	06.16.2010	JUN 16 2010	1160	7544.98	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ42	28.710370	-89.209400	06.16.2010	JUN 16 2010	55	82599.77	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ43	29.108100	-89.844600	06.16.2010	JUN 16 2010	19	150111.20	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ44	28.829100	-89.737400	06.16.2010	JUN 16 2010	59	134483.79	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ45	28.967150	-89.742230	06.16.2010	JUN 16 2010	48	136868.23	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	8	2010_0617_B88	BM88	28.729488	-88.366357	06.17.2010	JUN 17 2010	1559	961.80	4.45	4.11	0.17	0	0.06	0.01	0.32
Brooks McCall	8	2010_0617_B89	BM89	28.738313	-88.386968	06.17.2010	JUN 17 2010	1488	2058.01	4.44	3.85	0.22	0	0.17	0.02	1
Brooks McCall	8	2010_0617_B90	BM90	28.738512	-88.436113	06.17.2010	JUN 17 2010	1546	6868.68	4.41	4	0.2	0.01	0.51	0.04	3.34
Jack Fitz	3		JF005-C3	28.761833	-88.364833	06.17.2010	JUN 17 2010	1441	2633.82	-99	-99	-99	-99	-99	-99	-99
Jack Fitz	3		JF006-C3	28.743333	-88.396667	06.17.2010	JUN 17 2010	582	3062.06	-99	-99	-99	-99	-99	-99	-99
Jack Fitz	3		JF007-C3	28.757333	-88.369833	06.17.2010	JUN 17 2010	260	2165.46	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	8	2010_0618_B94	BM94	28.801513	-88.366598	06.18.2010	JUN 18 2010	1263	7039.00	-99	-99	-99	-99	-99	-99	-99
Jack Fitz	3		JF008-C3	28.755667	-88.358167	06.18.2010	JUN 18 2010	261	2090.26	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	8	2010_0619_B95	BM95	28.802070	-88.293720	06.19.2010	JUN 19 2010	1243	10019.18	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	8	2010_0619_B96	BM96	28.828752	-88.366687	06.19.2010	JUN 19 2010	1047	10064.36	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	8	2010_0619_B97	BM97	28.802875	-88.438483	06.19.2010	JUN 19 2010	1276	10103.39	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	8	2010_0619_B98	BM98	28.778050	-88.391312	06.19.2010	JUN 19 2010	1370	5080.56	4.3	3.83	0.25	0.03	0.54	0.07	9.48
Brooks McCall	8	2010_0619_B99	BM99	28.762563	-88.381593	06.19.2010	JUN 19 2010	1411	3115.10	4.34	3.84	0.22	0.01	0.18	0.03	3.24
Jack Fitz	3		JF009-C3	28.752167	-88.381000	06.19.2010	JUN 19 2010	1459	2144.43	-99	-99	-99	-99	-99	-99	-99
Jack Fitz	3		JF010-C3	28.813167	-88.409333	06.19.2010	JUN 19 2010	1106	9352.15	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ46	28.807260	-89.672760	06.19.2010	JUN 19 2010	71	128030.76	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ47	28.889430	-89.511880	06.19.2010	JUN 19 2010	33	113283.18	-99	-99	-99	-99	-99	-99	-99
Jack Fitz	3		JF011-C3	28.787833	-88.382167	06.20.2010	JUN 20 2010	1386	5743.07	-99	-99	-99	-99	-99	-99	-99
Jack Fitz	3		JF012-C3	28.772500	-88.372833	06.20.2010	JUN 20 2010	1411	3875.37	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ48	28.866600	-89.351700	06.20.2010	JUN 20 2010	58	97438.55	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ49	28.936000	-89.162800	06.20.2010	JUN 20 2010	41	80937.40	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ50	29.136200	-88.927800	06.20.2010	JUN 20 2010	36	70465.26	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ51	29.232740	-88.771320	06.20.2010	JUN 20 2010	66	67699.13	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ52	29.230800	-88.623890	06.20.2010	JUN 20 2010	67	60231.60	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ53	29.404480	-88.697850	06.20.2010	JUN 20 2010	40	80772.80	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ54	29.532000	-88.492900	06.21.2010	JUN 21 2010	46	89034.44	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ55	29.876100	-88.617500	06.21.2010	JUN 21 2010	18	128731.11	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ56	29.866100	-88.464500	06.21.2010	JUN 21 2010	23	125647.15	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	5		OV062	28.754515	-88.357993	06.22.2010	JUN 22 2010	18753	1978.32	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ57	29.818400	-87.523200	06.22.2010	JUN 22 2010	34	145437.77	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ58	29.731500	-87.229400	06.22.2010	JUN 22 2010	176	156414.85	-99	-99	-99	-99	-99	-99	-99

Appendix 5: QA / QC JAG Oxygen Data

Vessel	CruiseID	StationID	StationName	StationLat	StationLon	SampleDate	DateString	DepthOfCast	Dist2Wellhead	DO2_MEAN	DO2_MIN	DO2_SDEV	CDOM_MEAN	CDOM_MAX	CDOM_SDEV	CDOM_INT
Thomas Jefferson	3		TJ59	29.554920	-87.329870	06.22.2010	JUN 22 2010	198	135860.15	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ60	29.348790	-87.652690	06.22.2010	JUN 22 2010	176	97233.42	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ61	29.980470	-87.807210	06.22.2010	JUN 22 2010	272	148360.37	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ62	29.251100	-88.081600	06.22.2010	JUN 22 2010	191	63390.39	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	9	2010_0619_B100	BM100	28.696507	-88.384957	06.23.2010	JUN 23 2010	1594	4984.63	4.35	3.99	0.19	0	0.04	0	0.14
Brooks McCall	9	2010_0619_B101	BM101	28.693455	-88.366730	06.23.2010	JUN 23 2010	1143	4963.64	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	9	2010_0619_B102	BM102	28.715060	-88.371377	06.23.2010	JUN 23 2010	1582	2618.01	4.36	4.01	0.19	0	0.01	0	0.02
Thomas Jefferson	3		TJ63	29.172700	-88.483900	06.23.2010	JUN 23 2010	173	49619.77	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ64	28.959800	-88.814200	06.23.2010	JUN 23 2010	267	50262.50	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ65	28.822160	-89.103950	06.23.2010	JUN 23 2010	204	72788.00	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ66	28.773200	-88.363420	06.23.2010	JUN 23 2010	1186	3901.88	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	9		BM103	28.740107	-88.387755	06.24.2010	JUN 24 2010	1480	2146.09	4.34	3.98	0.18	0.42	5.94	1.19	127.4
Brooks McCall	9		BM104	28.738168	-88.417780	06.24.2010	JUN 24 2010	1495	5074.04	4.32	3.98	0.17	0.26	2.59	0.56	78.15
Brooks McCall	9		BM105	28.743882	-88.438368	06.24.2010	JUN 24 2010	1454	7117.76	4.27	3.91	0.2	0	0.06	0.01	0.23
Brooks McCall	9		BM106	28.729300	-88.416593	06.24.2010	JUN 24 2010	1521	5054.37	4.32	3.94	0.18	0.52	6.65	1.06	155.56
Thomas Jefferson	3		TJ67	28.802833	-88.378833	06.24.2010	JUN 24 2010	1166	7295.16	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ68	28.816833	-88.304833	06.24.2010	JUN 24 2010	1209	10590.66	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ69	28.817500	-88.333333	06.24.2010	JUN 24 2010	1218	9374.43	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	9		BM107	28.729640	-88.390192	06.25.2010	JUN 25 2010	1538	2554.44	4.34	3.82	0.2	0.71	4.01	1.11	212.71
Brooks McCall	9		BM108	28.721428	-88.386297	06.25.2010	JUN 25 2010	1566	2722.98	4.34	3.88	0.2	-99	-99	-99	-99
Brooks McCall	9		BM109	28.732040	-88.376750	06.25.2010	JUN 25 2010	1542	1256.10	4.36	3.99	0.17	0.89	3.53	1.14	268.56
Brooks McCall	9		BM110	28.711495	-88.407430	06.25.2010	JUN 25 2010	1553	5025.22	4.34	3.99	0.17	0	0.05	0.01	0.22
Brooks McCall	9		BM111	28.756102	-88.561648	06.25.2010	JUN 25 2010	1406	19257.61	4.29	3.98	0.17	0	0.02	0	0.03
Thomas Jefferson	3		TJ70	28.832833	-88.334000	06.25.2010	JUN 25 2010	1209	10972.26	-99	-99	-99	-99	-99	-99	-99
Thomas Jefferson	3		TJ71	28.725000	-88.420000	06.25.2010	JUN 25 2010	1210	5489.23	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	6		OV063	28.726027	-88.380862	06.26.2010	JUN 26 2010	1540	1985.55	4.38	4.02	0.17	1.62	12.13	3.36	487.63
Ocean Veritas	6		OV064	28.720631	-88.380568	06.26.2010	JUN 26 2010	1554	2414.76	4.39	4.03	0.17	0.02	0.53	0.08	6.72
Ocean Veritas	6		OV065	28.738276	-88.386492	06.26.2010	JUN 26 2010	1472	2011.38	4.35	4	0.17	0.01	0.6	0.06	3.36
Ocean Veritas	6		OV066	28.707779	-88.403271	06.26.2010	JUN 26 2010	1537	4972.41	4.36	4.01	0.18	0.67	8.64	1.85	202.17
Ocean Veritas	6		OV067	28.695697	-88.419291	06.26.2010	JUN 26 2010	1456	7035.67	4.36	3.98	0.2	0.08	2.98	0.38	25.32
Thomas Jefferson	3		TJ72	28.707000	-88.427167	06.26.2010	JUN 26 2010	1209	6920.01	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	6		OV068	28.701708	-88.395779	06.27.2010	JUN 27 2010	1556	4990.46	4.36	3.84	0.2	0.05	0.65	0.11	13.56
Ocean Veritas	6		OV069	28.730275	-88.416872	06.27.2010	JUN 27 2010	1497	5061.30	4.36	3.99	0.17	0.2	1.34	0.36	61.44
Ocean Veritas	6		OV070	28.730275	-88.416872	06.27.2010	JUN 27 2010	1502	5061.30	4.35	4.01	0.17	0.13	1.27	0.22	37.97
Ocean Veritas	6		OV071	28.716192	-88.410757	06.27.2010	JUN 27 2010	1523	5018.79	4.36	4.01	0.17	0.08	2.58	0.25	23.52
Ocean Veritas	6		OV072	28.705997	-88.413788	06.27.2010	JUN 27 2010	1525	5889.34	4.34	3.97	0.18	0	0.16	0.02	1.49
Ocean Veritas	6		OV073	28.726027	-88.380862	06.28.2010	JUN 28 2010	1542	1985.55	4.33	4	0.18	0.06	2.57	0.3	17.48
Ocean Veritas	6		OV074	28.720215	-88.367083	06.28.2010	JUN 28 2010	1566	1994.00	4.34	4	0.19	0.01	0.18	0.02	1.65
Ocean Veritas	6		OV075	28.732011	-88.376788	06.28.2010	JUN 28 2010	1519	1260.97	4.32	3.97	0.17	1.35	6.12	1.62	407.76
Ocean Veritas	7		OV076	28.732011	-88.376788	06.28.2010	JUN 28 2010	1537	1260.97	4.25	3.91	0.19	0	0.17	0.01	0.53
Nancy Foster	1		NF001	24.421333	-82.002500	07.01.2010	JUL 01 2010	47	799967.19	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF002	24.322833	-82.001000	07.01.2010	JUL 01 2010	198	806974.20	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF003	24.224000	-81.997500	07.01.2010	JUL 01 2010	585	814252.65	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF004	24.124000	-82.000333	07.02.2010	JUL 02 2010	739	821197.92	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF005	24.024000	-81.999500	07.02.2010	JUL 02 2010	910	828522.65	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF006	23.922833	-81.991667	07.02.2010	JUL 02 2010	1449	836563.90	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF007	23.825167	-81.996833	07.02.2010	JUL 02 2010	1410	843414.20	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	7		OV077	28.738276	-88.386492	07.02.2010	JUL 02 2010	1476	2011.38	4.22	3.91	0.19	1.86	10.58	3.2	561.02
Ocean Veritas	7		OV078	28.751320	-88.379964	07.02.2010	JUL 02 2010	1432	2006.46	4.22	3.92	0.16	0.17	1.84	0.38	52.44
Ocean Veritas	7		OV079	28.738277	-88.396630	07.02.2010	JUL 02 2010	1455	3003.76	4.21	3.93	0.18	0.84	9.63	1.9	254.27
Ocean Veritas	7		OV080	28.739294	-88.416913	07.02.2010	JUL 02 2010	1475	4990.79	4.26	3.9	0.19	0.29	4.92	0.96	86.61
Ocean Veritas	7		OV081	28.739824	-88.437527	07.02.2010	JUL 02 2010	1444	7009.42	4.29	3.91	0.21	0.01	0.14	0.02	1.87
Nancy Foster	1		NF008	23.722500	-81.997333	07.03.2010	JUL 03 2010	1562	851083.80	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF009	23.623833	-81.991000	07.03.2010	JUL 03 2010	1613	859052.73	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF010	23.522000	-81.999833	07.03.2010	JUL 03 2010	1635	866187.09	-99	-99	-99	-99	-99	-99	-99

Appendix 5: QA / QC JAG Oxygen Data

Vessel	CruiseID	StationID	StationName	StationLat	StationLon	SampleDate	DateString	DepthOfCast	Dist2Wellhead	DO2_MEAN	DO2_MIN	DO2_SDEV	CDOM_MEAN	CDOM_MAX	CDOM_SDEV	CDOM_INT
Nancy Foster	1		NF011	23.424833	-81.999000	07.03.2010	JUL 03 2010	1617	873771.37	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	7		OV082	28.748448	-88.416649	07.03.2010	JUL 03 2010	1424	5093.42	4.19	3.83	0.18	0.22	4.98	0.73	66.27
Ocean Veritas	7		OV083	28.757492	-88.416387	07.03.2010	JUL 03 2010	1382	5384.78	4.15	3.86	0.18	0.69	7.4	1.51	207.95
Ocean Veritas	7		OV084	28.777792	-88.407763	07.03.2010	JUL 03 2010	1332	6012.10	4.23	3.87	0.23	0.26	3.58	0.64	77.15
Nancy Foster	1		NF012	23.219167	-83.252000	07.04.2010	JUL 04 2010	1993	802446.00	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF013	23.434833	-83.389833	07.04.2010	JUL 04 2010	2073	774715.29	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF014	23.648333	-83.529667	07.04.2010	JUL 04 2010	2102	747089.95	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF015	23.861167	-83.669333	07.04.2010	JUL 04 2010	1658	719583.78	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	7		OV085	28.786948	-88.407640	07.04.2010	JUL 04 2010	1308	6785.02	4.21	3.78	0.24	0.06	1.19	0.17	16.96
Ocean Veritas	7		OV086	28.787752	-88.438242	07.04.2010	JUL 04 2010	1301	8967.76	4.26	3.82	0.24	0.02	0.87	0.08	5.31
Ocean Veritas	7		OV087	28.769946	-88.438824	07.04.2010	JUL 04 2010	1349	7959.64	4.24	3.8	0.24	0.04	1.45	0.2	11.68
Ocean Veritas	7		OV088	28.757492	-88.416387	07.04.2010	JUL 04 2010	1385	5384.78	4.19	3.76	0.21	0.22	3.91	0.64	65.48
Ocean Veritas	7		OV089	28.721636	-88.417376	07.04.2010	JUL 04 2010	1517	5358.18	4.28	3.9	0.21	0	0.15	0.02	0.99
Ocean Veritas	7		OV090	28.774371	-88.462373	07.04.2010	JUL 04 2010	1340	10259.38	4.27	3.81	0.24	0.02	0.28	0.04	5.23
Brooks McCall	11		BM112	28.741400	-88.346283	07.05.2010	JUL 05 2010	1066	1958.49	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	11		BM113	28.745800	-88.347750	07.05.2010	JUL 05 2010	1527	1973.88	4.23	3.87	0.22	0.09	1.71	0.28	28.1
Nancy Foster	1		NF016	24.078167	-83.810500	07.05.2010	JUL 05 2010	1444	691677.30	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF017	24.292833	-83.950167	07.05.2010	JUL 05 2010	1386	664130.13	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF018	24.508167	-84.090500	07.05.2010	JUL 05 2010	1544	636546.96	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	11		BM115	28.722317	-88.357567	07.06.2010	JUL 06 2010	1577	1939.46	4.14	3.73	0.22	0.05	1.23	0.21	16.05
Brooks McCall	11		BM116	28.736767	-88.346150	07.06.2010	JUL 06 2010	1552	1943.82	4.21	3.91	0.2	0.16	3.47	0.54	47.49
Brooks McCall	11		BM117	28.742523	-88.352078	07.06.2010	JUL 06 2010	1535	1442.10	4.19	3.89	0.17	0.04	1.12	0.17	12.66
Nancy Foster	1		NF019	25.080833	-83.002667	07.06.2010	JUL 06 2010	33	673581.97	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF020	25.060333	-83.091000	07.06.2010	JUL 06 2010	36	667956.54	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF021	25.036667	-83.176167	07.06.2010	JUL 06 2010	40	662883.93	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF022	25.012167	-83.263667	07.06.2010	JUL 06 2010	44	657769.94	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF023	24.989000	-83.352500	07.06.2010	JUL 06 2010	46	652543.04	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF024	24.973167	-83.441833	07.06.2010	JUL 06 2010	50	646824.50	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF025	24.946833	-83.532500	07.06.2010	JUL 06 2010	52	641869.87	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF026	24.925833	-83.617333	07.06.2010	JUL 06 2010	50	637050.97	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF027	24.904167	-83.708000	07.06.2010	JUL 06 2010	63	631935.23	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF030	24.833667	-83.993667	07.06.2010	JUL 06 2010	168	616648.48	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF031	24.813667	-84.077667	07.06.2010	JUL 06 2010	323	612293.28	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF032	24.780000	-84.235833	07.06.2010	JUL 06 2010	1347	604015.94	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF033	24.707500	-84.499333	07.06.2010	JUL 06 2010	1983	592361.67	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF034	24.639333	-84.765500	07.07.2010	JUL 07 2010	1982	581222.03	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF035	24.565500	-85.038167	07.07.2010	JUL 07 2010	378	571335.19	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF036	24.505333	-85.291500	07.07.2010	JUL 07 2010	1997	562485.21	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF037	24.438000	-85.554000	07.07.2010	JUL 07 2010	1993	554949.82	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF038	24.377000	-85.815500	07.07.2010	JUL 07 2010	1986	548083.87	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF039	24.194833	-86.522333	07.08.2010	JUL 08 2010	1458	537724.45	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF040	24.783500	-85.701333	07.08.2010	JUL 08 2010	1982	514127.68	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	8		OV091	28.751768	-88.365511	07.08.2010	JUL 08 2010	1444	1514.23	4.32	4	0.16	0.01	0.23	0.03	2.83
Ocean Veritas	8		OV092	28.744873	-88.373085	07.08.2010	JUL 08 2010	1457	1023.56	4.31	3.99	0.16	0.38	1.43	0.24	114.41
Ocean Veritas	8		OV093	28.738276	-88.386493	07.08.2010	JUL 08 2010	7947	2011.48	4.29	3.95	0.17	0.03	1.01	0.13	8.9
Ocean Veritas	8		OV094	28.730040	-88.377441	07.08.2010	JUL 08 2010	1536	1440.77	4.31	3.97	0.18	0.11	2.14	0.38	34.51
Ocean Veritas	8		OV095	28.724765	-88.366360	07.08.2010	JUL 08 2010	1555	1486.08	4.31	3.98	0.18	0	0.03	0	0.06
Nancy Foster	1		NF041	25.132333	-85.805667	07.09.2010	JUL 09 2010	1988	475418.27	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF042	25.461000	-85.898333	07.09.2010	JUL 09 2010	1985	439546.64	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF043	25.869333	-85.997833	07.09.2010	JUL 09 2010	1989	396437.82	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF044	25.510000	-86.522500	07.09.2010	JUL 09 2010	992	403034.39	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	8		OV096	28.693076	-88.368057	07.09.2010	JUL 09 2010	1595	5009.40	4.32	3.97	0.2	0.01	0.21	0.03	1.88
Ocean Veritas	8		OV097	28.707723	-88.403559	07.09.2010	JUL 09 2010	1545	4997.37	4.27	3.93	0.18	0.32	3.85	0.78	97.41
Ocean Veritas	8		OV098	28.695553	-88.419376	07.09.2010	JUL 09 2010	1447	7052.57	4.24	3.9	0.19	0.3	3.61	0.72	89.79
Ocean Veritas	8		OV099	28.686359	-88.440700	07.09.2010	JUL 09 2010	1328	9308.41	4.21	3.9	0.18	0.2	3.73	0.58	59.04

Appendix 5: QA / QC JAG Oxygen Data

Vessel	CruiseID	StationID	StationName	StationLat	StationLon	SampleDate	DateString	DepthOfCast	Dist2Wellhead	DO2_MEAN	DO2_MIN	DO2_SDEV	CDOM_MEAN	CDOM_MAX	CDOM_SDEV	CDOM_INT
Ocean Veritas	8		OV100	28.689102	-88.400276	07.09.2010	JUL 09 2010	1532	6400.20	4.26	3.95	0.18	0.02	0.4	0.07	6.71
Nancy Foster	1		NF045	25.248333	-86.920167	07.10.2010	JUL 10 2010	1983	413733.49	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF046	24.791500	-86.790500	07.10.2010	JUL 10 2010	1979	466002.49	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF047	24.862333	-86.589167	07.10.2010	JUL 10 2010	1991	465909.48	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF048	24.996833	-86.201000	07.10.2010	JUL 10 2010	1992	468723.43	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	8		OV101	28.716923	-88.422624	07.10.2010	JUL 10 2010	1503	6028.40	4.25	3.92	0.15	0	0.2	0.02	1.23
Ocean Veritas	8		OV102	28.716676	-88.392402	07.10.2010	JUL 10 2010	1554	3520.20	4.29	3.95	0.16	0.14	2.45	0.44	41.65
Ocean Veritas	8		OV103	28.705872	-88.438227	07.10.2010	JUL 10 2010	1364	7932.31	4.24	3.9	0.16	0	0.15	0.02	0.96
Ocean Veritas	8		OV104	28.678488	-88.464278	07.10.2010	JUL 10 2010	1369	11687.30	4.22	3.94	0.15	0.02	0.63	0.07	5.7
Ocean Veritas	8		OV105	28.757061	-88.398296	07.10.2010	JUL 10 2010	1378	3800.40	4.22	3.99	0.12	0	0.12	0.02	1.23
Brooks McCall	12		BM118	28.737883	-88.397367	07.11.2010	JUL 11 2010	1477	3076.01	4.25	4.02	0.11	0	0.05	0	0.09
Brooks McCall	12		BM119	28.711533	-88.365117	07.11.2010	JUL 11 2010	1591	2956.25	4.34	4.03	0.15	0	0.08	0	0.11
Brooks McCall	12		BM120	28.715550	-88.382883	07.11.2010	JUL 11 2010	1578	3007.47	4.27	4.01	0.14	0.01	0.29	0.04	3.29
Brooks McCall	12		BM121	28.719785	-88.387598	07.11.2010	JUL 11 2010	1568	2941.02	4.29	4.01	0.14	0	0.08	0.01	0.18
Brooks McCall	12		BM122	28.708033	-88.388700	07.11.2010	JUL 11 2010	1579	4017.99	4.29	4.02	0.15	0	0.12	0.01	0.73
Nancy Foster	1		NF049	25.131833	-85.802167	07.11.2010	JUL 11 2010	1981	475654.14	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF050	25.262500	-85.447333	07.11.2010	JUL 11 2010	1990	483902.08	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF051	25.381833	-85.097833	07.11.2010	JUL 11 2010	1987	495549.77	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF052	25.502167	-84.756833	07.11.2010	JUL 11 2010	1992	508952.30	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF053	25.621833	-84.409000	07.11.2010	JUL 11 2010	192	525092.87	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	12		BM123	28.712800	-88.375767	07.12.2010	JUL 12 2010	1584	2974.16	4.3	4.11	0.12	0.19	1.86	0.29	55.77
Brooks McCall	12		BM124	28.708417	-88.377350	07.12.2010	JUL 12 2010	1589	3484.99	4.31	4.09	0.13	0.34	1.67	0.37	103.12
Brooks McCall	12		BM125	28.704200	-88.378800	07.12.2010	JUL 12 2010	1595	3974.15	4.31	4.09	0.13	0.83	4.06	1.03	248.46
Brooks McCall	12		BM127	28.700000	-88.441667	07.12.2010	JUL 12 2010	1303	8538.36	4.16	4	0.08	0	0.07	0	0.13
Nancy Foster	1		NF054	25.976500	-83.364000	07.12.2010	JUL 12 2010	45	585305.49	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	12		BM128	28.695483	-88.381967	07.13.2010	JUL 13 2010	1597	4990.66	4.29	4	0.15	0.1	2.09	0.35	30.31
Brooks McCall	12		BM129	28.705100	-88.382617	07.13.2010	JUL 13 2010	1589	4016.27	4.27	4.03	0.15	0.2	1.42	0.38	58.71
Brooks McCall	12		BM130	28.711998	-88.371748	07.13.2010	JUL 13 2010	1584	2958.58	4.29	4.02	0.17	0.55	4.24	0.99	164.04
Nancy Foster	1		NF055	27.472000	-83.265167	07.14.2010	JUL 14 2010	24	523608.56	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF056	27.315500	-83.603000	07.14.2010	JUL 14 2010	39	496993.29	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF057	27.117833	-84.026833	07.14.2010	JUL 14 2010	73	465743.08	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF058	26.959833	-84.367667	07.14.2010	JUL 14 2010	144	442573.61	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF059	26.802667	-84.704500	07.14.2010	JUL 14 2010	236	421802.27	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF060	26.645000	-85.045667	07.14.2010	JUL 14 2010	1988	403106.23	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF061	26.481667	-85.387333	07.14.2010	JUL 14 2010	1985	387580.04	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	9		OV106	28.731247	-88.379414	07.14.2010	JUL 14 2010	1531	1524.66	4.25	3.99	0.19	0	0.09	0.01	0.17
Ocean Veritas	9		OV107	28.713035	-88.403393	07.14.2010	JUL 14 2010	1536	4606.06	4.24	4.01	0.17	0	0.06	0	0.06
Ocean Veritas	9		OV108	28.712916	-88.384273	07.14.2010	JUL 14 2010	1555	3326.89	4.28	4	0.18	0	0.04	0	0.08
Ocean Veritas	9		OV109	28.696338	-88.385079	07.14.2010	JUL 14 2010	1574	5006.50	4.28	4.01	0.17	0	0.04	0	0.04
Ocean Veritas	9		OV110	28.769229	-88.354335	07.14.2010	JUL 14 2010	1450	3635.19	4.22	3.98	0.2	0	0.12	0.01	0.32
Nancy Foster	1		NF062	26.322000	-85.728000	07.15.2010	JUL 15 2010	1993	375075.18	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF063	26.165000	-86.071333	07.15.2010	JUL 15 2010	1990	365684.88	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF064	26.008833	-86.410167	07.15.2010	JUL 15 2010	1990	360251.44	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF065	25.846667	-86.746000	07.15.2010	JUL 15 2010	1980	359438.04	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF066	25.688500	-87.087833	07.15.2010	JUL 15 2010	1981	361938.90	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	9		OV111	28.744080	-88.468196	07.15.2010	JUL 15 2010	1407	10030.37	4.23	4.03	0.15	0.03	0.76	0.07	7.68
Ocean Veritas	9		OV112	28.734271	-88.411528	07.15.2010	JUL 15 2010	1486	4482.78	4.21	4.03	0.13	0.01	0.64	0.06	3.8
Ocean Veritas	9		OV113	28.725322	-88.404076	07.15.2010	JUL 15 2010	1516	3995.09	4.2	4.03	0.12	0.01	0.3	0.04	3
Ocean Veritas	9		OV114	28.698000	-88.407000	07.15.2010	JUL 15 2010	1530	6002.68	4.17	4.02	0.08	0.02	0.32	0.05	5.81
Ocean Veritas	9		OV115	28.699233	-88.340284	07.15.2010	JUL 15 2010	1470	4998.69	4.31	4.03	0.21	0.01	0.33	0.04	2.8
Ocean Veritas	9		OV116	28.711779	-88.352935	07.15.2010	JUL 15 2010	1566	3192.95	4.28	4.02	0.2	0.01	0.18	0.02	1.78
Nancy Foster	1		NF067	25.494500	-87.514500	07.16.2010	JUL 16 2010	2001	370197.36	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF068	26.512333	-87.773500	07.16.2010	JUL 16 2010	1978	254126.82	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF069	26.926500	-87.884667	07.16.2010	JUL 16 2010	1990	206788.25	-99	-99	-99	-99	-99	-99	-99
Seward Johnson	1		SJ26	24.441500	-83.159667	07.16.2010	JUL 16 2010	97.35	708323.48	-99	-99	-99	-99	-99	-99	-99

Appendix 5: QA / QC JAG Oxygen Data

Vessel	CruiseID	StationID	StationName	StationLat	StationLon	SampleDate	DateString	DepthOfCast	Dist2Wellhead	DO2_MEAN	DO2_MIN	DO2_SDEV	CDOM_MEAN	CDOM_MAX	CDOM_SDEV	CDOM_INT
Seward Johnson	1		SJ28	24.444500	-83.131833	07.16.2010	JUL 16 2010	110.261	710169.68	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	13		BM131	28.668142	-88.486125	07.17.2010	JUL 17 2010	1695	14103.74	3.95	3.59	0.16	0.01	0.29	0.03	1.72
Brooks McCall	13		BM132	28.654783	-88.473833	07.17.2010	JUL 17 2010	1695	14047.12	3.98	3.65	0.16	0	0.2	0.02	1.41
Brooks McCall	13		BM133	28.636438	-88.467028	07.17.2010	JUL 17 2010	1836	15019.25	3.95	3.62	0.16	0.01	0.59	0.04	1.65
Brooks McCall	13		BM134	28.633017	-88.445100	07.17.2010	JUL 17 2010	1300	14014.52	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF070	28.005167	-88.173833	07.17.2010	JUL 17 2010	1978	83574.38	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF071	28.617833	-88.436667	07.17.2010	JUL 17 2010	1429	15050.30	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF072	28.630000	-88.246500	07.17.2010	JUL 17 2010	1917	16767.72	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF073	28.756833	-88.399167	07.17.2010	JUL 17 2010	1382	3858.03	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF074	29.270667	-87.855167	07.17.2010	JUL 17 2010	231	77389.90	-99	-99	-99	-99	-99	-99	-99
Nancy Foster	1		NF075	29.999333	-88.451000	07.17.2010	JUL 17 2010	17	140324.41	-99	-99	-99	-99	-99	-99	-99
Seward Johnson	1		SJ30	24.879667	-83.651667	07.17.2010	JUL 17 2010	50.667	638003.74	-99	-99	-99	-99	-99	-99	-99
Seward Johnson	1		SJ32	24.948167	-83.631667	07.17.2010	JUL 17 2010	52.653	634281.10	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	13		BM135	28.620483	-88.417167	07.18.2010	JUL 18 2010	1400	13997.34	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	13		BM136	28.618490	-88.411380	07.18.2010	JUL 18 2010	1493	14014.15	-99	-99	-99	-99	-99	-99	-99
Ferrel	2		BP-TN05-SS01	28.586742	-88.473869	07.18.2010	JUL 18 2010	1286	19861.64	-99	-99	-99	-99	-99	-99	-99
Ferrel	2		BP-TN05-SS02	28.570944	-88.425442	07.18.2010	JUL 18 2010	1349	19462.60	4	3.6	0.18	0.08	1.03	0.22	23.68
Ferrel	2		BP-TN05-SS03	28.570625	-88.320333	07.18.2010	JUL 18 2010	1350	19134.93	4.01	3.61	0.19	-99	-99	-99	-99
Brooks McCall	13		BM137	28.728900	-88.224850	07.19.2010	JUL 19 2010	1590	13851.80	4.3	3.97	0.18	0	0.04	0	0.04
Brooks McCall	13		BM138	28.629750	-88.292917	07.19.2010	JUL 19 2010	1785	14003.64	4.13	3.89	0.14	0	0.05	0.01	0.33
Brooks McCall	13		BM139	28.672950	-88.208783	07.19.2010	JUL 19 2010	1792	17009.27	4.25	3.99	0.14	0	0	0	0
Brooks McCall	13		BM140	28.706200	-88.227550	07.19.2010	JUL 19 2010	1500	14007.56	4.28	3.95	0.18	0	0.03	0	0.11
Ferrel	2		BP-TN05-SS04	28.611472	-88.231589	07.19.2010	JUL 19 2010	1743	19265.90	4.1	3.8	0.14	0.2	1.81	0.4	61.08
Seward Johnson	1		SJ35	26.373167	-83.772167	07.19.2010	JUL 19 2010	69.531	526840.89	-99	-99	-99	-99	-99	-99	-99
Seward Johnson	1		SJ37	26.338000	-84.755667	07.19.2010	JUL 19 2010	481.27	446951.21	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	10		OV123	28.649033	-88.480761	07.20.2010	JUL 20 2010	1484	14978.44	4.15	3.77	0.18	0.03	0.56	0.08	10.18
Ocean Veritas	10		OV124	28.605641	-88.396858	07.20.2010	JUL 20 2010	1744	15024.29	4.17	4	0.09	0.01	0.4	0.05	2.44
Ocean Veritas	10		OV125	28.550186	-88.483499	07.20.2010	JUL 20 2010	1692	23840.53	4.21	3.84	0.21	0.05	1.43	0.18	15.1
Ocean Veritas	10		OV126	28.526192	-88.447950	07.20.2010	JUL 20 2010	1737	24872.94	4.21	3.83	0.2	0.1	1.84	0.28	30.27
Ocean Veritas	10		OV127	28.483187	-88.474006	07.20.2010	JUL 20 2010	1700	30230.73	4.26	3.7	0.23	0.02	0.32	0.05	5.99
Seward Johnson	1		SJ39	26.336667	-84.758500	07.20.2010	JUL 20 2010	484.244	446815.33	-99	-99	-99	-99	-99	-99	-99
Seward Johnson	1		SJ41	27.727333	-84.517167	07.20.2010	JUL 20 2010	110.234	395920.40	-99	-99	-99	-99	-99	-99	-99
Seward Johnson	1		SJ43	27.609167	-84.206833	07.20.2010	JUL 20 2010	50.656	429353.83	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	10		OV133	28.512829	-88.330309	07.22.2010	JUL 22 2010	1593	25267.47	4.13	3.56	0.19	0.05	1.05	0.17	-99
Ocean Veritas	10		OV134	28.527014	-88.271819	07.22.2010	JUL 22 2010	1604	25199.09	4.26	3.54	0.24	0.06	0.89	0.15	17.05
Ocean Veritas	10		OV135	28.487966	-88.243903	07.22.2010	JUL 22 2010	1600	30253.07	4.33	3.99	0.18	0.01	0.2	0.02	1.95
Ocean Veritas	10		OV136	28.467708	-88.372679	07.22.2010	JUL 22 2010	1739	30042.97	4.21	3.85	0.19	0.05	1.03	0.11	15.43
Ocean Veritas	10		OV137	28.418935	-88.372093	07.22.2010	JUL 22 2010	1701	35457.78	4.27	3.66	0.22	0.02	0.43	0.06	5.17
Seward Johnson	1		SJ45	27.613833	-84.224667	07.22.2010	JUL 22 2010	60.587	427503.39	-99	-99	-99	-99	-99	-99	-99
Ferrel	3		TN05-SS06	28.570219	-88.322792	07.25.2010	JUL 25 2010	1399	19124.05	4.34	4.03	0.16	0	0.05	0.01	0.25
Ferrel	3		TN05-SS08	28.659217	-88.110550	07.26.2010	JUL 26 2010	1341	26505.89	-99	-99	-99	-99	-99	-99	-99
Ferrel	3		TN05-SS09	28.659578	-88.110994	07.26.2010	JUL 26 2010	1203	26451.55	-99	-99	-99	-99	-99	-99	-99
Ferrel	3		TN05-SS10	28.570242	-88.322442	07.27.2010	JUL 27 2010	1399	19129.18	4.05	3.71	0.18	0	0.05	0	0.17
Ocean Veritas	11		OV138	28.376637	-88.379316	07.27.2010	JUL 27 2010	1601	40171.66	4.22	3.57	0.2	0.04	0.79	0.11	11.01
Ocean Veritas	11		OV139	28.426127	-88.580203	07.27.2010	JUL 27 2010	1474	40518.38	4.07	3.66	0.17	0.04	0.53	0.11	12.92
Ocean Veritas	11		OV140	28.352121	-88.630984	07.27.2010	JUL 27 2010	1491	50130.15	4.24	3.66	0.23	0.01	0.2	0.03	2.21
Ocean Veritas	11		OV141	28.446947	-88.758943	07.27.2010	JUL 27 2010	1254	50289.80	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	11		OV142	28.560495	-88.835740	07.27.2010	JUL 27 2010	1091	50066.10	-99	-99	-99	-99	-99	-99	-99
Ferrel	3		TN06-SS02	29.287175	-88.714183	07.28.2010	JUL 28 2010	52	69806.36	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	11		OV143	28.419289	-88.798559	07.28.2010	JUL 28 2010	1245	55241.47	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	11		OV144	28.506489	-88.679978	07.28.2010	JUL 28 2010	1339	40106.48	4.1	2.56	0.47	0.2	2.23	0.53	59.32
Ocean Veritas	11		OV145	28.595598	-88.741086	07.28.2010	JUL 28 2010	1226	40005.34	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	11		OV146	28.562980	-88.600591	07.28.2010	JUL 28 2010	1456	30112.16	4.17	3.85	0.2	0.01	0.21	0.03	2.01
Ocean Veritas	11		OV147	28.466095	-88.512076	07.28.2010	JUL 28 2010	1579	33435.48	4.05	3.7	0.1	0.01	0.38	0.04	3.31
Ocean Veritas	11		OV148	28.409738	-88.506047	07.28.2010	JUL 28 2010	1586	38972.07	4.01	3.64	0.13	0.04	0.5	0.08	11.68

Appendix 5: QA / QC JAG Oxygen Data

Vessel	CruiseID	StationID	StationName	StationLat	StationLon	SampleDate	DateString	DepthOfCast	Dist2Wellhead	DO2_MEAN	DO2_MIN	DO2_SDEV	CDOM_MEAN	CDOM_MAX	CDOM_SDEV	CDOM_INT
Brooks McCall	15		BM141	28.738340	-88.386975	07.29.2010	JUL 29 2010	1495	2058.73	4.34	4.04	0.17	0	0	0	0
Brooks McCall	15		BM142	28.720555	-88.366500	07.29.2010	JUL 29 2010	1580	1953.88	4.38	4.05	0.17	0	0.01	0	0.03
Brooks McCall	15		BM143	28.738532	-88.346115	07.29.2010	JUL 29 2010	1545	1941.72	4.38	4.07	0.15	0	0.02	0	0.05
Brooks McCall	15		BM144	28.756610	-88.366500	07.29.2010	JUL 29 2010	1440	2052.14	4.35	4.08	0.15	0	0.06	0	0.16
Brooks McCall	15		BM145	28.706643	-88.402682	07.30.2010	JUL 30 2010	1560	5017.29	4.35	4.05	0.17	0	0.03	0	0.03
Brooks McCall	15		BM146	28.706643	-88.330318	07.30.2010	JUL 30 2010	1469	4940.20	4.4	4.09	0.18	0	0.09	0.01	0.11
Brooks McCall	15		BM147	28.770480	-88.236038	07.30.2010	JUL 30 2010	1381	13213.40	4.3	4.03	0.15	0	0.02	0	0.05
Brooks McCall	15		BM148	28.000000	-88.236038	07.30.2010	JUL 30 2010	1370	82973.74	4.37	4.06	0.16	0	0.05	0	0.05
Brooks McCall	15		BM149	28.446947	-88.758893	07.31.2010	JUL 31 2010	1269	50275.06	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	15		BM150	28.345667	-88.777833	07.31.2010	JUL 31 2010	1427	59416.92	4.2	3.81	0.18	0	0.08	0.01	0.42
Brooks McCall	15		BM151	28.324833	-88.938167	07.31.2010	JUL 31 2010	1194	72486.30	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	15		BM152	28.235667	-89.129000	07.31.2010	JUL 31 2010	1098	93346.13	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	15		BM153	28.131083	-88.998767	07.31.2010	JUL 31 2010	1033	91648.88	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	12		OV149	28.325024	-88.937608	08.01.2010	AUG 1 2010	1178	72429.48	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	12		OV150	28.328528	-89.154702	08.01.2010	AUG 1 2010	808	89711.41	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	12		OV151	28.141061	-89.406980	08.01.2010	AUG 1 2010	1065	121762.41	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	12		OV152	28.291092	-88.871448	08.01.2010	AUG 1 2010	1362	70155.30	4.26	3.96	0.19	0	0.19	0.02	1.25
Ferrel	4		TN08-SS02	28.345247	-88.778650	08.02.2010	AUG 2 2010	1350	59505.56	4.12	3.72	0.14	0.01	0.13	0.02	2.82
Ferrel	4		TN08-SS03	28.447183	-88.759406	08.02.2010	AUG 2 2010	1260	50307.69	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	12		OV153	28.289597	-88.771428	08.02.2010	AUG 2 2010	1509	63736.30	4.1	3.81	0.16	0	0.1	0.01	0.72
Ocean Veritas	12		OV154	28.290594	-88.811783	08.02.2010	AUG 2 2010	1408	66193.49	4.12	3.72	0.19	0.02	0.28	0.05	4.76
Ocean Veritas	12		OV155	28.287290	-89.005709	08.02.2010	AUG 2 2010	1067	80262.62	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	12		OV156	28.144973	-88.855005	08.02.2010	AUG 2 2010	1343	81496.06	4.16	3.18	0.4	0.06	0.44	0.11	16.72
Ocean Veritas	12		OV157	28.135657	-88.817498	08.02.2010	AUG 2 2010	1604	80246.78	4.3	3.77	0.22	0	0.12	0.02	1.39
American Diver	1		AD003	28.380900	-88.745940	08.03.2010	AUG 3 2010	981	54419.61	-99	-99	-99	-99	-99	-99	-99
Henry Bigelow	1		HB1006001	28.702000	-88.336167	08.03.2010	AUG 3 2010	-99	4961.19	-99	-99	-99	-99	-99	-99	-99
Henry Bigelow	1		HB1006002	28.695000	-88.334333	08.03.2010	AUG 3 2010	1026	5704.32	-99	-99	-99	-99	-99	-99	-99
Henry Bigelow	1		HB1006003	28.722333	-88.322333	08.03.2010	AUG 3 2010	1403	4616.53	4.31	3.7	0.21	0.08	1.03	0.16	22.68
American Diver	1		AD004	28.363810	-89.036340	08.04.2010	AUG 4 2010	781	77758.51	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	16		BM154	28.182517	-88.825150	08.04.2010	AUG 4 2010	1577	76398.06	4.12	3.44	0.17	0	0.09	0.01	0.24
Brooks McCall	16		BM155	28.182517	-88.825150	08.04.2010	AUG 4 2010	1421	76398.06	4.09	3.58	0.18	0	0.07	0.01	0.33
Brooks McCall	16		BM156	28.182517	-88.825150	08.04.2010	AUG 4 2010	1577	76398.06	4.12	3.47	0.17	0	0.04	0	0.16
Brooks McCall	16		BM157	28.218783	-88.794853	08.04.2010	AUG 4 2010	1449	71389.66	4.11	3.91	0.19	0	0.05	0	0.06
Henry Bigelow	1		HB1006004	28.697000	-88.224667	08.04.2010	AUG 4 2010	1677	14568.99	4.29	4.03	0.14	0.01	0.15	0.02	2.46
Henry Bigelow	1		HB1006005	28.720000	-88.286333	08.04.2010	AUG 4 2010	313	8050.57	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	16		BM158	28.150302	-88.789157	08.05.2010	AUG 5 2010	1684	77367.60	4.1	3.75	0.11	0	0	0	0
Brooks McCall	16		BM159	28.192187	-88.753747	08.05.2010	AUG 5 2010	1402	71576.84	4.08	3.91	0.1	0	0	0	0
Brooks McCall	16		BM160	28.224392	-88.716838	08.05.2010	AUG 5 2010	1449	66631.47	4.12	3.87	0.14	0	0.08	0.01	0.32
Brooks McCall	16		BM161	28.254368	-88.759372	08.05.2010	AUG 5 2010	1449	66145.09	4.14	3.9	0.14	0	0.03	0	0.12
Gordon Gunter	3		GU001	28.643167	-88.369667	08.05.2010	AUG 5 2010	1671	10554.68	4.09	3.78	0.15	0	0.12	0.01	0.22
Gordon Gunter	3		GU002	28.647500	-88.393500	08.05.2010	AUG 5 2010	1453	10422.37	4.09	3.81	0.16	0.01	0.31	0.04	2.31
Gordon Gunter	3		GU003	28.551500	-88.585000	08.05.2010	AUG 5 2010	1532	29835.36	4.11	3.83	0.16	0.01	0.26	0.03	1.59
Henry Bigelow	1		HB1006006	28.817833	-88.299833	08.05.2010	AUG 5 2010	1011	10963.94	-99	-99	-99	-99	-99	-99	-99
Henry Bigelow	1		HB1006007	28.851000	-88.264500	08.05.2010	AUG 5 2010	1003	15989.67	-99	-99	-99	-99	-99	-99	-99
Henry Bigelow	1		HB1006008	28.849000	-88.240500	08.05.2010	AUG 5 2010	119	17386.53	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	16		BM162	28.233790	-88.899600	08.06.2010	AUG 6 2010	1355	76658.79	4.21	3.92	0.18	0	0.01	0	0.01
Brooks McCall	16		BM163	28.312782	-88.970867	08.06.2010	AUG 6 2010	1154	75822.32	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	16		BM164	28.249603	-89.043497	08.06.2010	AUG 6 2010	1158	85781.80	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	16		BM165	28.318985	-89.108068	08.06.2010	AUG 6 2010	864	86372.51	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	16		BM166	28.385847	-89.178100	08.06.2010	AUG 6 2010	718	88692.30	-99	-99	-99	-99	-99	-99	-99
Brooks McCall	16		BM167	28.000000	-89.178100	08.06.2010	AUG 6 2010	1079	114344.97	-99	-99	-99	-99	-99	-99	-99
Gordon Gunter	3		GU004	28.457500	-88.690833	08.06.2010	AUG 6 2010	1351	44553.81	4.05	3.72	0.17	0	0.19	0.02	1.13
Gordon Gunter	3		GU005	28.346500	-88.795500	08.06.2010	AUG 6 2010	1427	60540.52	3.93	3.68	0.18	0.01	0.26	0.03	2.66
Gordon Gunter	3		GU006	28.254500	-88.908667	08.06.2010	AUG 6 2010	1356	75615.02	3.93	3.61	0.17	0.01	0.28	0.03	1.92
Gordon Gunter	3		GU007	28.152500	-88.747500	08.06.2010	AUG 6 2010	1725	75041.68	3.85	3.72	0.13	0	0.24	0.02	1

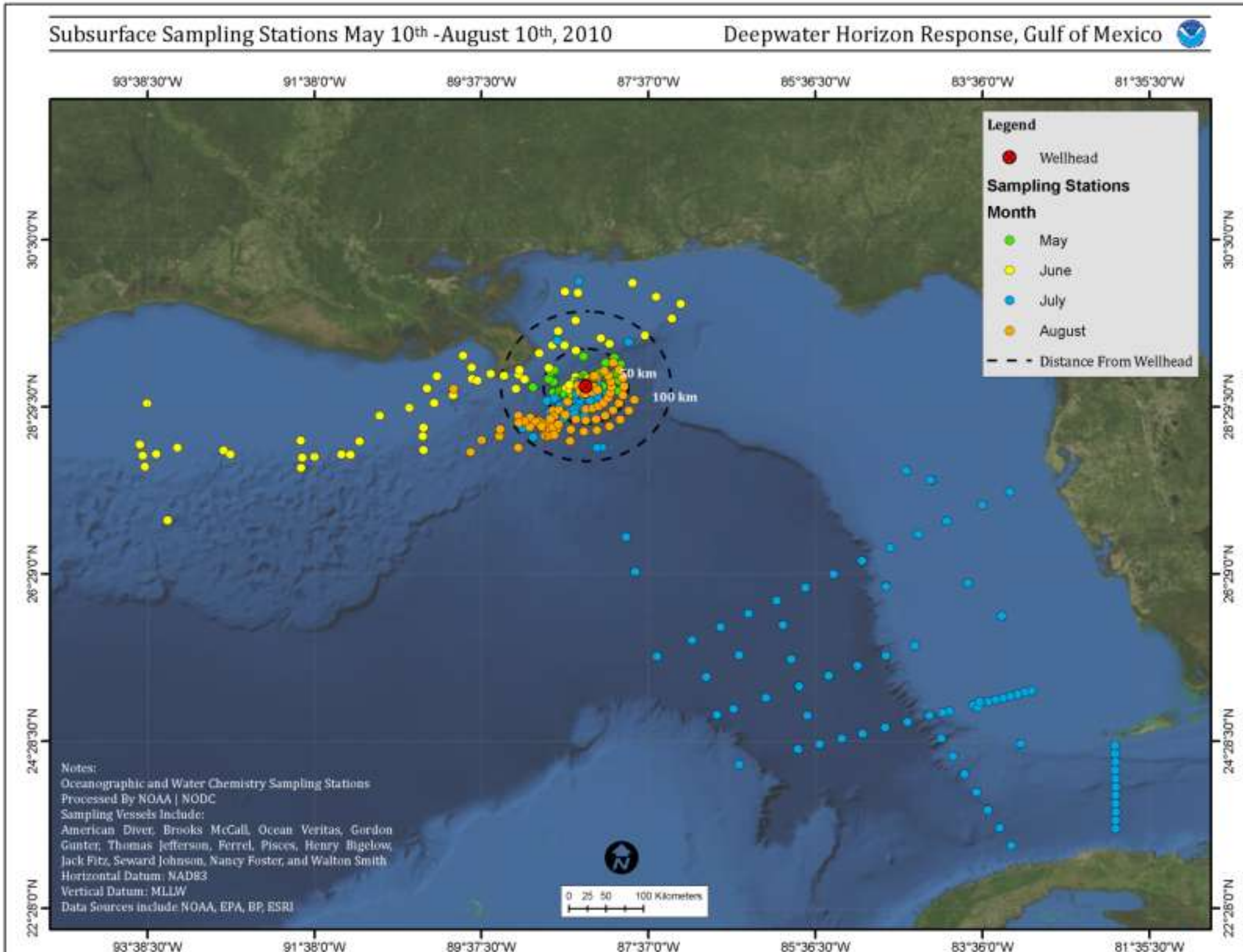
Appendix 5: QA / QC JAG Oxygen Data

Vessel	CruiseID	StationID	StationName	StationLat	StationLon	SampleDate	DateString	DepthOfCast	Dist2Wellhead	DO2_MEAN	DO2_MIN	DO2_SDEV	CDOM_MEAN	CDOM_MAX	CDOM_SDEV	CDOM_INT
Gordon Gunter	3		GU008	28.083833	-88.556000	08.06.2010	AUG 6 2010	1951	75020.29	4.13	3.82	0.18	0	0.16	0.01	0.49
Henry Bigelow	1		HB1006009	28.723333	-88.323500	08.06.2010	AUG 6 2010	1460	4469.03	4.25	3.97	0.16	0	0.11	0.01	1.05
Pisces	1		PC001	28.468167	-88.366167	08.06.2010	AUG 6 2010	1847	29984.89	-99	-99	-99	-99	-99	-99	-99
Pisces	1		PC002	28.476500	-88.287167	08.06.2010	AUG 6 2010	1921	30068.99	4.06	3.75	0.19	0.01	0.28	0.03	2.11
Pisces	1		PC003	28.502500	-88.215000	08.06.2010	AUG 6 2010	1995	30065.54	4.06	3.74	0.17	0	0.21	0.02	1.32
Pisces	1		PC004	28.544000	-88.153333	08.06.2010	AUG 6 2010	2056	29985.55	4.06	3.73	0.16	0	0.14	0.01	0.29
Brooks McCall	16		BM168	28.708862	-89.957602	08.07.2010	AUG 7 2010	55	155744.50	-99	-99	-99	-99	-99	-99	-99
Gordon Gunter	3		GU009	28.852833	-88.275333	08.07.2010	AUG 7 2010	1205	15520.75	-99	-99	-99	-99	-99	-99	-99
Gordon Gunter	3		GU010	28.867000	-88.264500	08.07.2010	AUG 7 2010	1213	17417.53	-99	-99	-99	-99	-99	-99	-99
Henry Bigelow	1		HB1006010	28.708333	-88.336000	08.07.2010	AUG 7 2010	1398	4422.20	4.25	3.99	0.15	0	0.09	0.01	0.49
Henry Bigelow	1		HB1006011	28.705500	-88.395833	08.07.2010	AUG 7 2010	1424	4658.82	4.25	3.31	0.24	0	0.13	0.02	1.27
Henry Bigelow	1		HB1006012	28.771333	-88.341167	08.07.2010	AUG 7 2010	1373	4412.95	4.22	3.92	0.17	0	0.05	0	0.1
Henry Bigelow	1		HB1006013	28.780167	-88.370833	08.07.2010	AUG 7 2010	1287	4692.25	-99	-99	-99	-99	-99	-99	-99
Henry Bigelow	1		HB1006014	28.766667	-88.399833	08.07.2010	AUG 7 2010	1354	4586.91	4.22	3.93	0.15	0	0.02	0	0.02
Henry Bigelow	1		HB1006015	28.736167	-88.412333	08.07.2010	AUG 7 2010	1469	4546.22	4.19	3.91	0.15	0	0.08	0.01	0.7
Henry Bigelow	1		HB1006016	28.704000	-88.395000	08.07.2010	AUG 7 2010	1540	4740.20	4.21	3.83	0.17	0	0.16	0.01	1.07
Ocean Veritas	13		OV158	27.949961	-89.751912	08.07.2010	AUG 7 2010	820	161777.01	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	13		OV159	28.093040	-89.620002	08.07.2010	AUG 7 2010	697	142374.58	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	13		OV160	28.226164	-89.397306	08.07.2010	AUG 7 2010	967	116026.02	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	13		OV161	28.300934	-89.176281	08.07.2010	AUG 7 2010	880	93109.02	-99	-99	-99	-99	-99	-99	-99
Ocean Veritas	13		OV162	28.258000	-88.901453	08.07.2010	AUG 7 2010	1339	74840.91	-99	-99	-99	-99	-99	-99	-99
Pisces	1		PC005	28.599667	-88.103000	08.07.2010	AUG 7 2010	2117	30003.88	4.04	3.76	0.16	0	0.24	0.02	0.97
Pisces	1		PC006	28.663833	-88.071500	08.07.2010	AUG 7 2010	1774	29996.75	4.06	3.65	0.21	0	0.14	0.01	0.47
Pisces	1		PC007	28.732333	-88.060000	08.07.2010	AUG 7 2010	1979	29962.36	4.02	3.65	0.21	0	0.15	0.01	0.15
Pisces	1		PC008	28.801000	-88.068833	08.07.2010	AUG 7 2010	1756	29907.43	4	3.69	0.17	0	0.09	0.01	0.11
Pisces	1		PC009	28.865333	-88.095833	08.07.2010	AUG 7 2010	1563	29969.26	3.98	3.69	0.17	0.02	0.35	0.05	4.68
Pisces	1		PC010	28.922000	-88.142333	08.07.2010	AUG 7 2010	1146	29925.86	-99	-99	-99	-99	-99	-99	-99
Henry Bigelow	1		HB1006017	28.696333	-88.355833	08.08.2010	AUG 8 2010	1567	4747.76	4.23	3.91	0.17	0	0.1	0.01	1.41
Henry Bigelow	1		HB1006018	28.737333	-88.266000	08.08.2010	AUG 8 2010	1274	9784.79	-99	-99	-99	-99	-99	-99	-99
Henry Bigelow	1		HB1006019	28.674167	-88.295167	08.08.2010	AUG 8 2010	1422	9926.17	4.21	3.97	0.14	0	0.07	0.01	0.22
Henry Bigelow	1		HB1006020	28.778167	-88.365500	08.08.2010	AUG 8 2010	1344	4445.89	-99	-99	-99	-99	-99	-99	-99
Henry Bigelow	1		HB1006021	28.758000	-88.330833	08.08.2010	AUG 8 2010	1407	4083.88	4.21	3.89	0.18	0	0.06	0.01	0.53
Henry Bigelow	1		HB1006022	28.701500	-88.358667	08.08.2010	AUG 8 2010	1566	4131.45	4.23	3.95	0.16	0	0.13	0.01	1.2
Henry Bigelow	1		HB1006023	28.703833	-88.393500	08.08.2010	AUG 8 2010	1003	4668.66	-99	-99	-99	-99	-99	-99	-99
Pisces	1		PC011	29.024167	-88.039667	08.08.2010	AUG 8 2010	1250	45026.07	-99	-99	-99	-99	-99	-99	-99
Pisces	1		PC012	28.939333	-87.966167	08.08.2010	AUG 8 2010	1564	45042.80	4.01	3.71	0.17	0.01	0.25	0.03	2.1
Pisces	1		PC013	28.842500	-87.920833	08.08.2010	AUG 8 2010	1526	45078.29	4.04	3.6	0.22	0	0.24	0.03	1.36
Pisces	1		PC014	28.736333	-87.905500	08.08.2010	AUG 8 2010	2130	45086.24	4.01	3.66	0.18	0.01	0.39	0.04	2.49
Pisces	1		PC015	28.632000	-87.921333	08.08.2010	AUG 8 2010	2236	45124.64	4.06	3.69	0.17	0.02	0.34	0.05	5.25
Pisces	1		PC016	28.533500	-87.968500	08.08.2010	AUG 8 2010	2231	45101.87	4.11	3.78	0.16	0.01	0.57	0.04	2.45
Pisces	1		PC017	28.450833	-88.041000	08.08.2010	AUG 8 2010	2182	45095.48	4.12	3.8	0.17	0.01	0.42	0.05	3.46
Pisces	1		PC018	28.386833	-88.135667	08.08.2010	AUG 8 2010	2026	45086.52	4.13	3.83	0.15	0.01	0.47	0.06	3.91
Pisces	1		PC019	28.346000	-88.245500	08.08.2010	AUG 8 2010	1981	45129.71	4.15	3.81	0.16	0.01	0.28	0.04	2.31
Pisces	1		PC020	28.332000	-88.365667	08.08.2010	AUG 8 2010	1791	45108.10	4.13	3.88	0.17	0.01	0.36	0.05	3.92
Henry Bigelow	1		HB1006024	28.745500	-88.466000	08.09.2010	AUG 9 2010	1387	9827.69	4.16	3.9	0.18	0	0.1	0.01	1.05
Henry Bigelow	1		HB1006025	28.676833	-88.438167	08.09.2010	AUG 9 2010	1263	9816.80	-99	-99	-99	-99	-99	-99	-99
Henry Bigelow	1		HB1006026	28.650333	-88.372167	08.09.2010	AUG 9 2010	1589	9771.41	4.22	3.91	0.17	0	0.14	0.02	1.5
Henry Bigelow	1		HB1006027	28.670833	-88.293000	08.09.2010	AUG 9 2010	1438	10339.99	4.21	3.92	0.16	0	0.1	0.01	0.63
Henry Bigelow	1		HB1006028	28.733667	-88.265333	08.09.2010	AUG 9 2010	1307	9862.34	-99	-99	-99	-99	-99	-99	-99
Henry Bigelow	1		HB1006029	28.696000	-88.224667	08.09.2010	AUG 9 2010	1738	14604.28	4.23	3.87	0.19	0	0.07	0.01	0.62
Pisces	1		PC021	28.345500	-88.484833	08.09.2010	AUG 9 2010	1665	45137.69	4.19	3.8	0.17	0.02	0.43	0.06	5.45
Pisces	1		PC022	28.396000	-88.611833	08.09.2010	AUG 9 2010	1484	44997.09	4.27	4.03	0.11	0	0.27	0.03	1.13
Pisces	1		PC023	28.281833	-88.693333	08.09.2010	AUG 9 2010	1593	59989.53	4.18	3.94	0.15	0	0.09	0.01	0.13
Pisces	1		PC024	28.222000	-88.546667	08.09.2010	AUG 9 2010	1694	59999.65	4.14	3.53	0.22	0.01	0.43	0.04	2.63
Pisces	1		PC025	28.198333	-88.389500	08.09.2010	AUG 9 2010	1983	59997.21	4.16	3.55	0.2	0.02	0.51	0.07	5.52

Appendix 5: QA / QC JAG Oxygen Data

Vessel	CruiseID	StationID	StationName	StationLat	StationLon	SampleDate	DateString	DepthOfCast	Dist2Wellhead	DO2_MEAN	DO2_MIN	DO2_SDEV	CDOM_MEAN	CDOM_MAX	CDOM_SDEV	CDOM_INT
Pisces	1		PC026	28.211000	-88.232333	08.09.2010	AUG 9 2010	2111	60001.47	4.18	3.86	0.17	0.01	0.26	0.03	2.68
Pisces	1		PC027	28.258667	-88.084167	08.09.2010	AUG 9 2010	2232	60011.04	4.18	3.87	0.17	0.01	0.3	0.03	2.24
Pisces	1		PC028	28.340500	-87.952000	08.09.2010	AUG 9 2010	2222	60003.20	4.17	3.83	0.18	0.02	0.45	0.06	4.89
Pisces	1		PC029	28.447333	-87.850167	08.09.2010	AUG 9 2010	2338	60013.91	4.09	3.74	0.2	0.01	0.35	0.04	3.27
Pisces	1		PC030	28.576500	-87.781667	08.09.2010	AUG 9 2010	2341	60009.39	4.01	3.68	0.18	0.02	0.29	0.05	5.16

Map 1. Survey area and month of station occupation for monitoring for subsurface dispersed oil.



Map 2. Detail of survey area and month of station occupation for monitoring for subsurface dispersed oil.

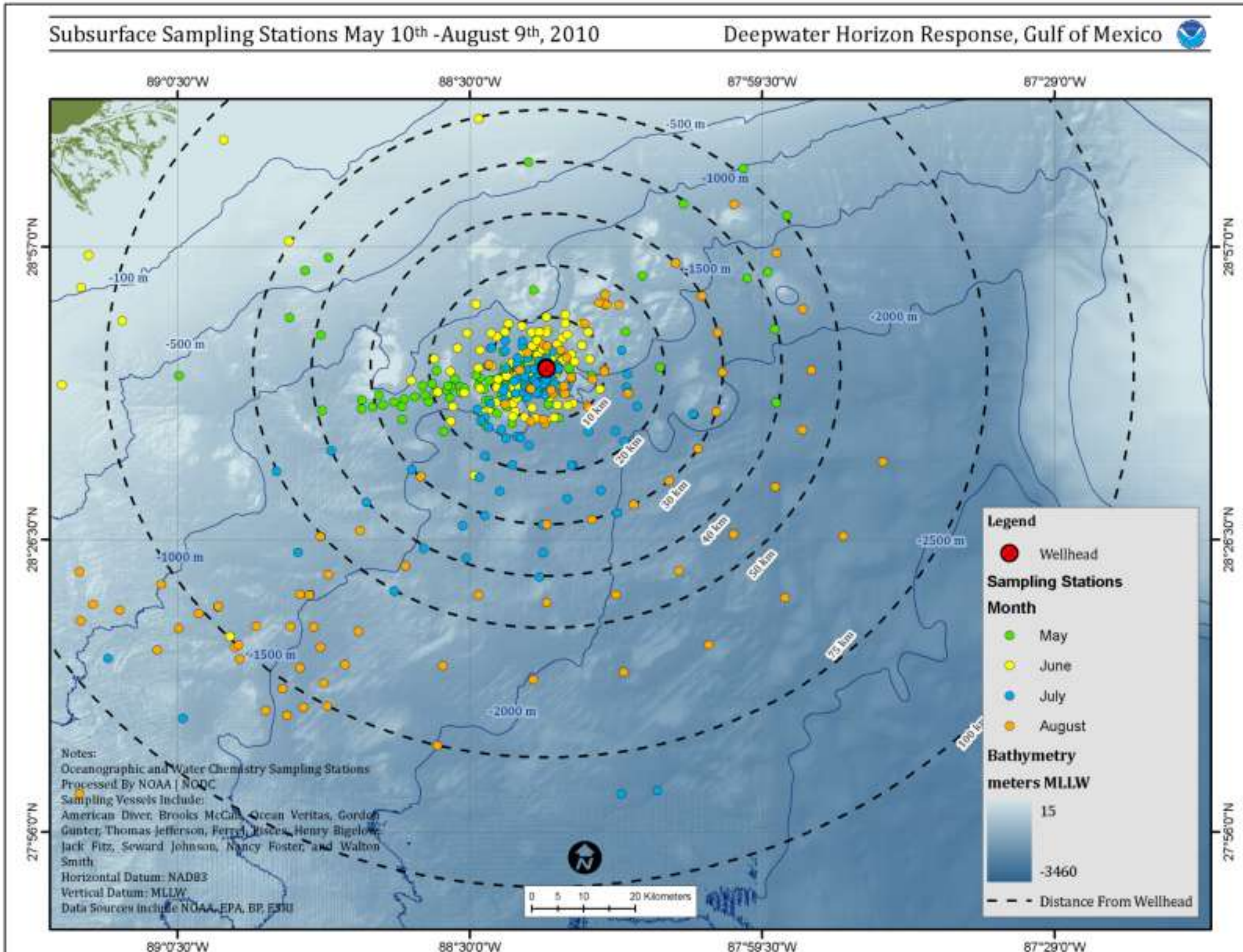


Figure 1. Poor quality CTD data from R/V *Ocean Veritas* cruise 4, most likely attributable to a faulty electrical connection between the cable and the CTD.

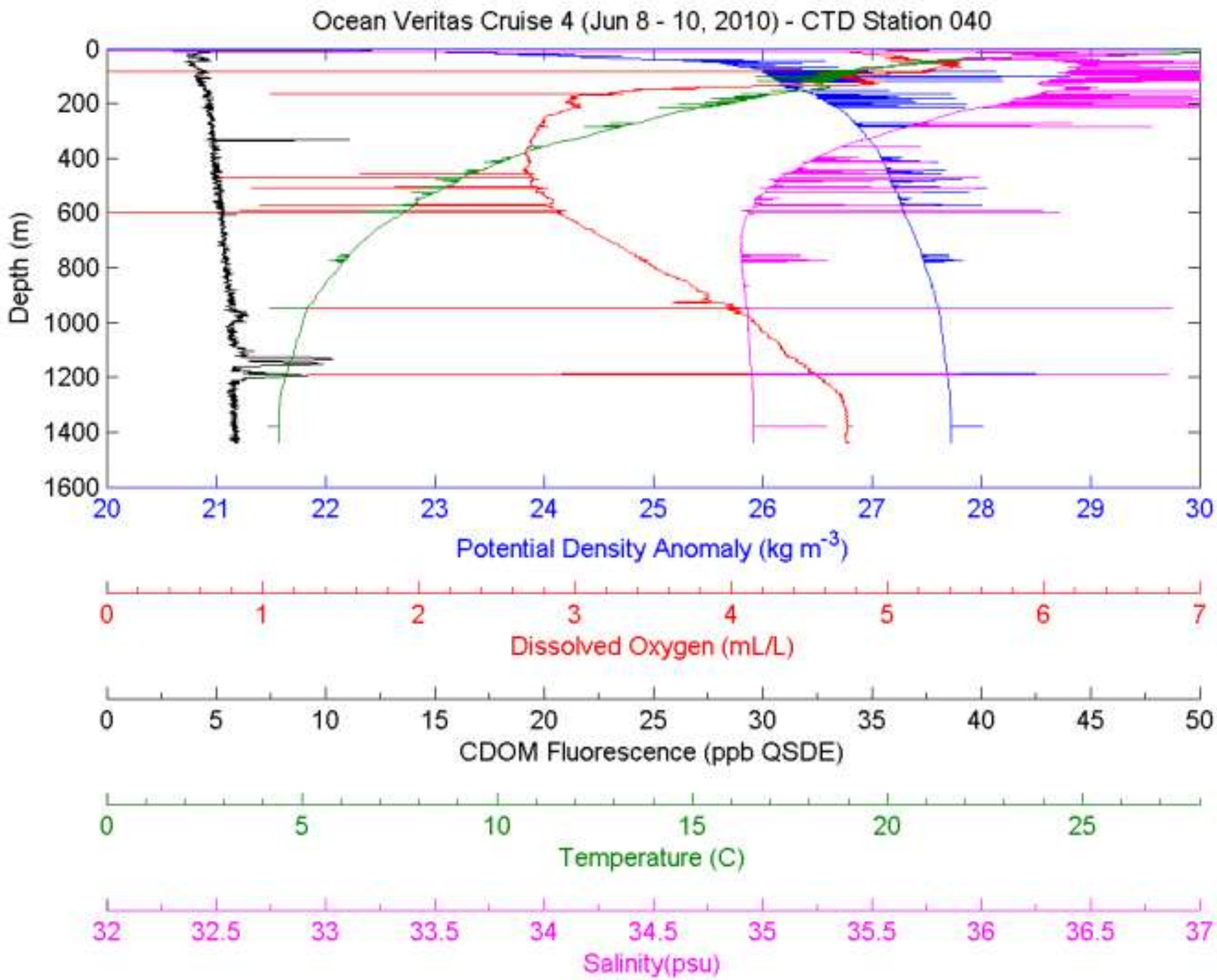


Figure 2. Historical Winkler measurements of dissolved oxygen (mL/L) around the spill site. Data are from the NODC World Ocean Database 2009. (World Ocean Atlas 2009 climatologies of dissolved oxygen using only discreet Winkler O_2 measurements).

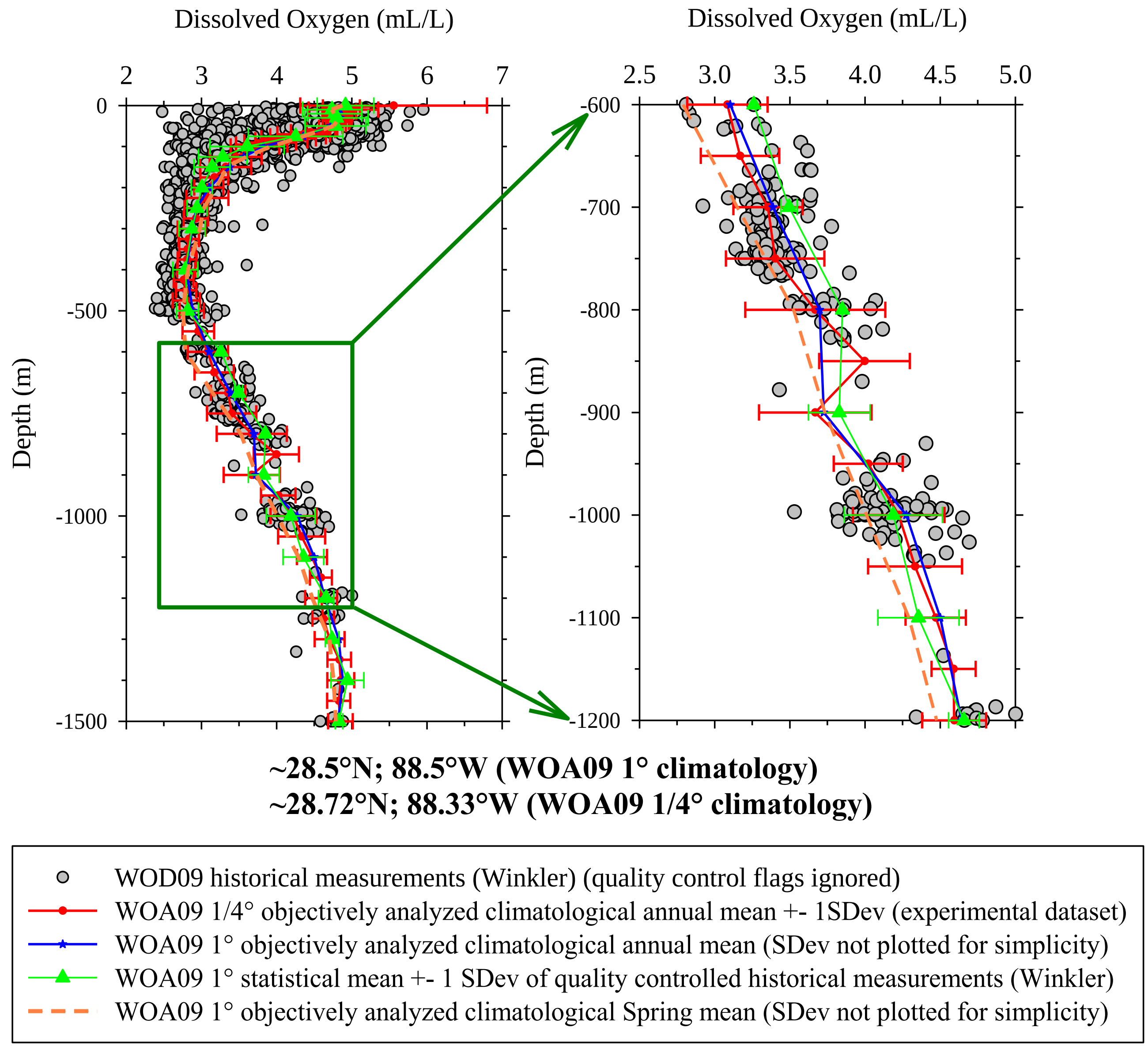


Figure 3. Historical CTD dissolved oxygen (mL/L) data available in the NODC World Ocean Database 2009.

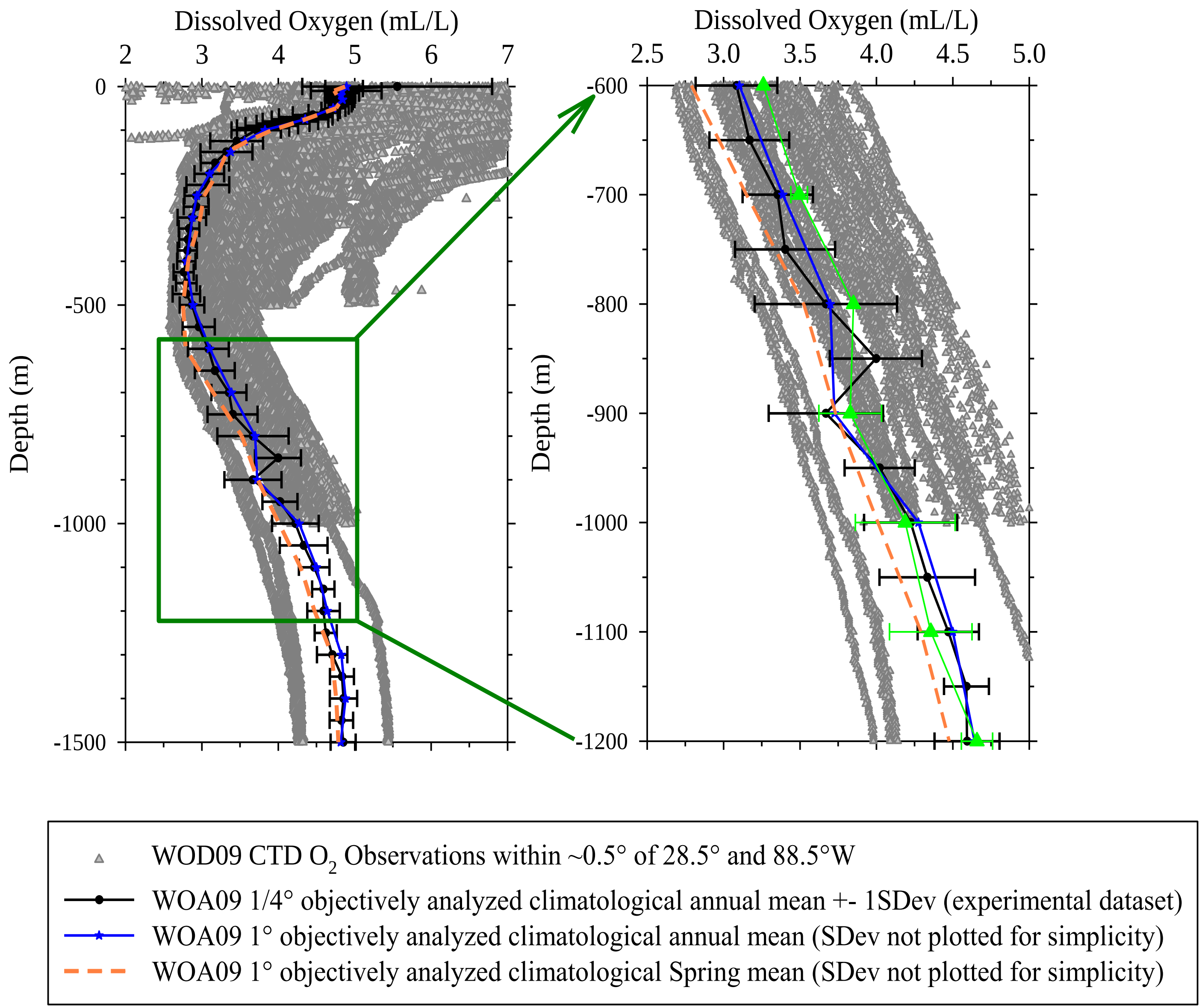


Figure 4 – Annual variations in dissolved oxygen at 28.5 °N 88.5 °W based on the climatological mean DO2 from the NODC 1° World Ocean Atlas 2009.

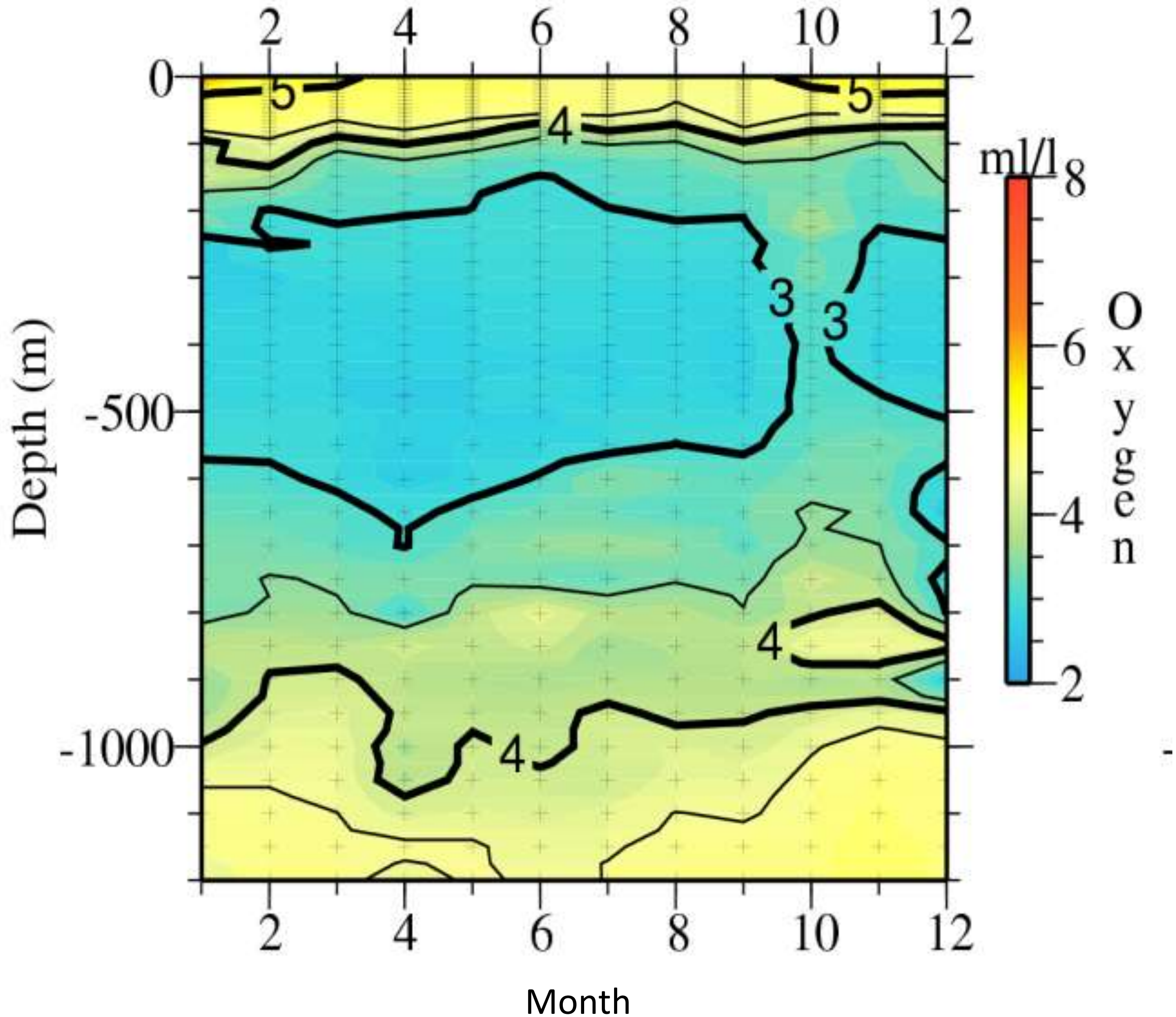


Figure 5. Variations in CTD DO_2 profile slope within the 500-800 m depth range as recorded during the R/V *Brooks McCall* and R/V *Ocean Veritas* cruises. The red line indicates the expect slope of 1.

Preliminary Data Subject To Change

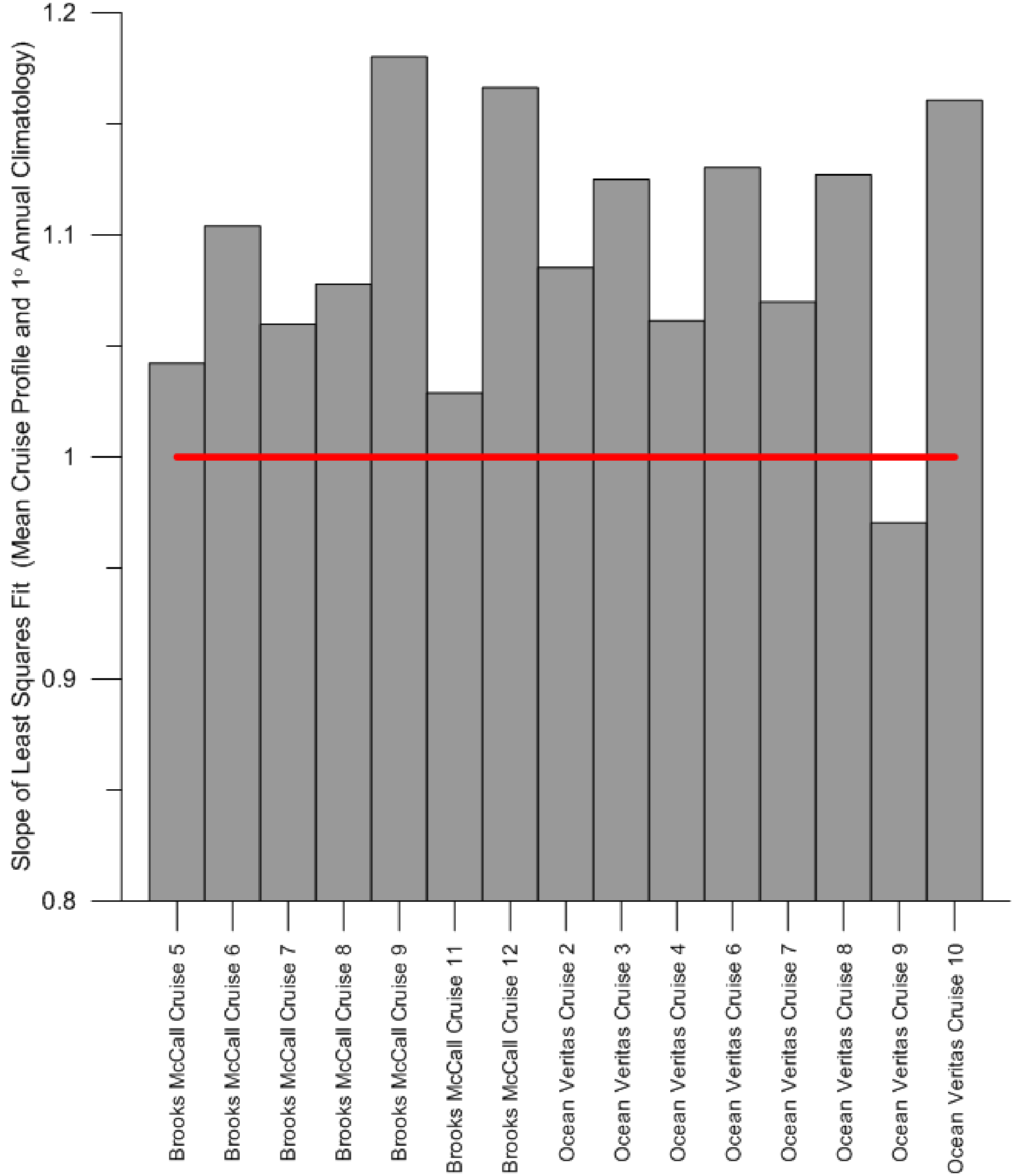


Figure 6. Dissolved oxygen profiles for 419 profiles as compared to mean and standard deviation for 1° ocean climatology for area around the wellhead. Vertical red dashed line indicates the DO_2 level for hypoxia (1.4 mL/L)

Preliminary Data Subject To Change

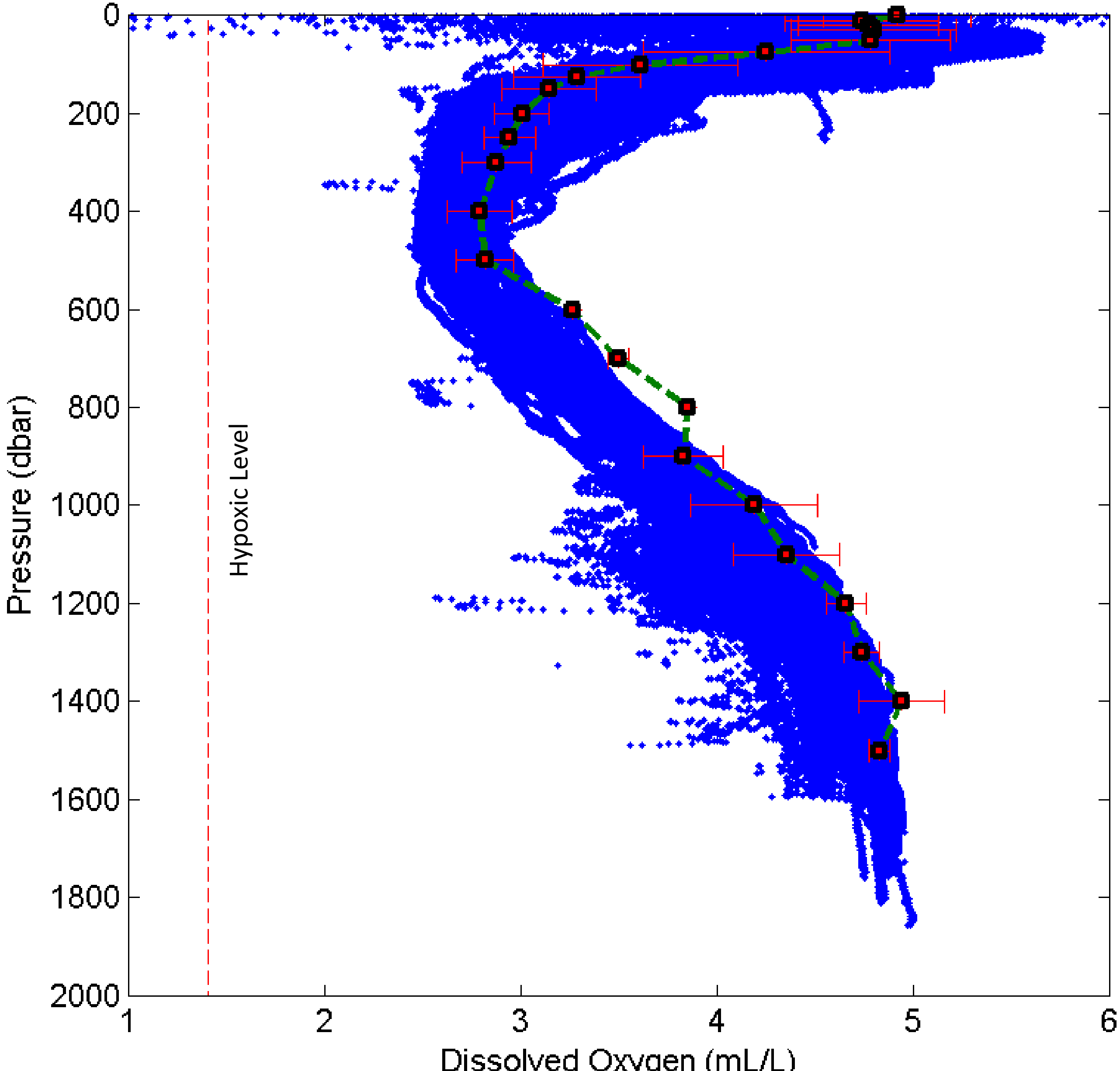


Figure 7. CDOM fluorescence, dissolved oxygen, and density profiles for R/V *Walton Smith* Station 15a showing the second largest DO_2 depression in the data used for this report.

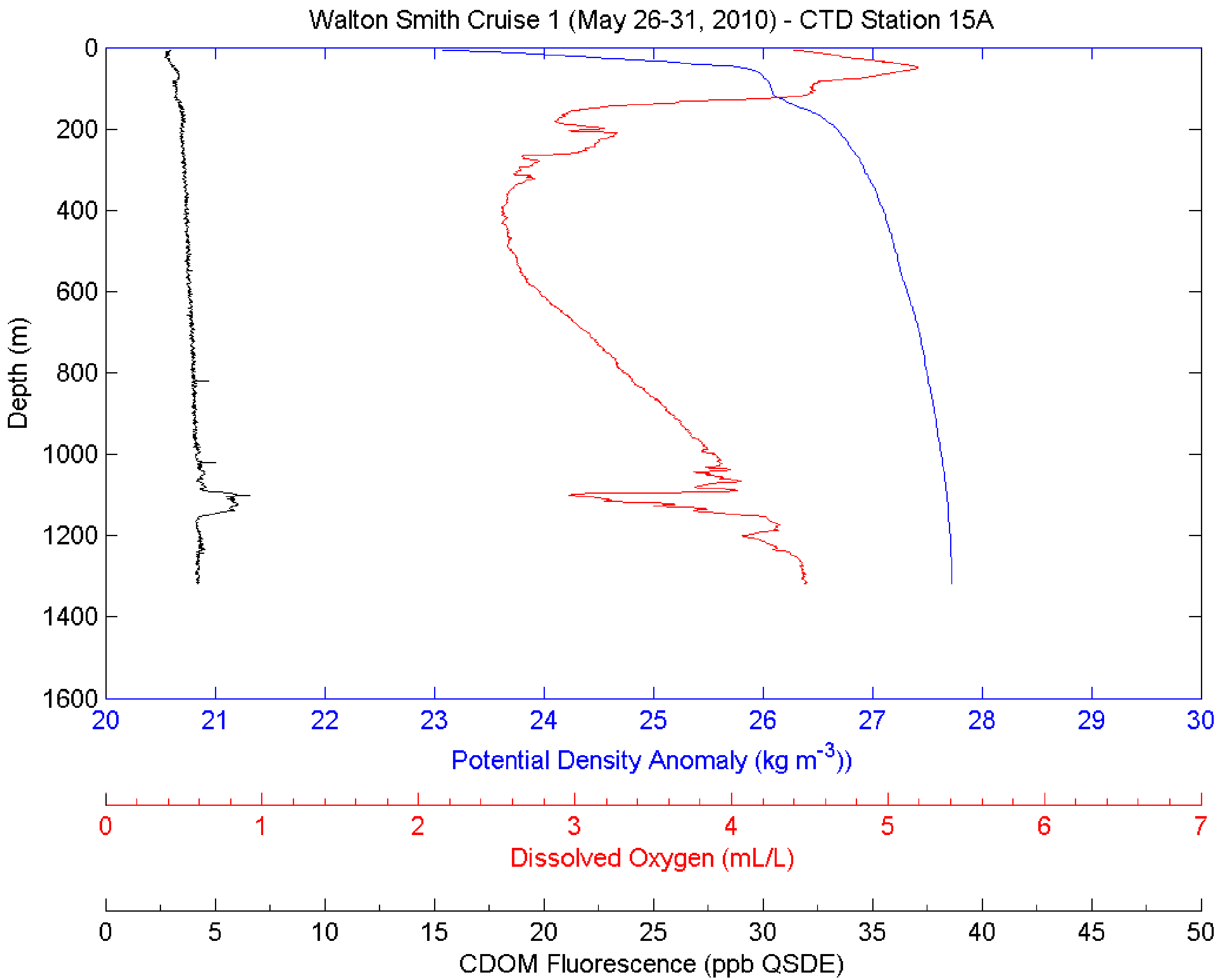


Figure 8. CDOM fluorescence, dissolved oxygen, and density profiles for R/V *Ocean Veritas* Station 144 showing the largest DO_2 depression in the data used for this report.

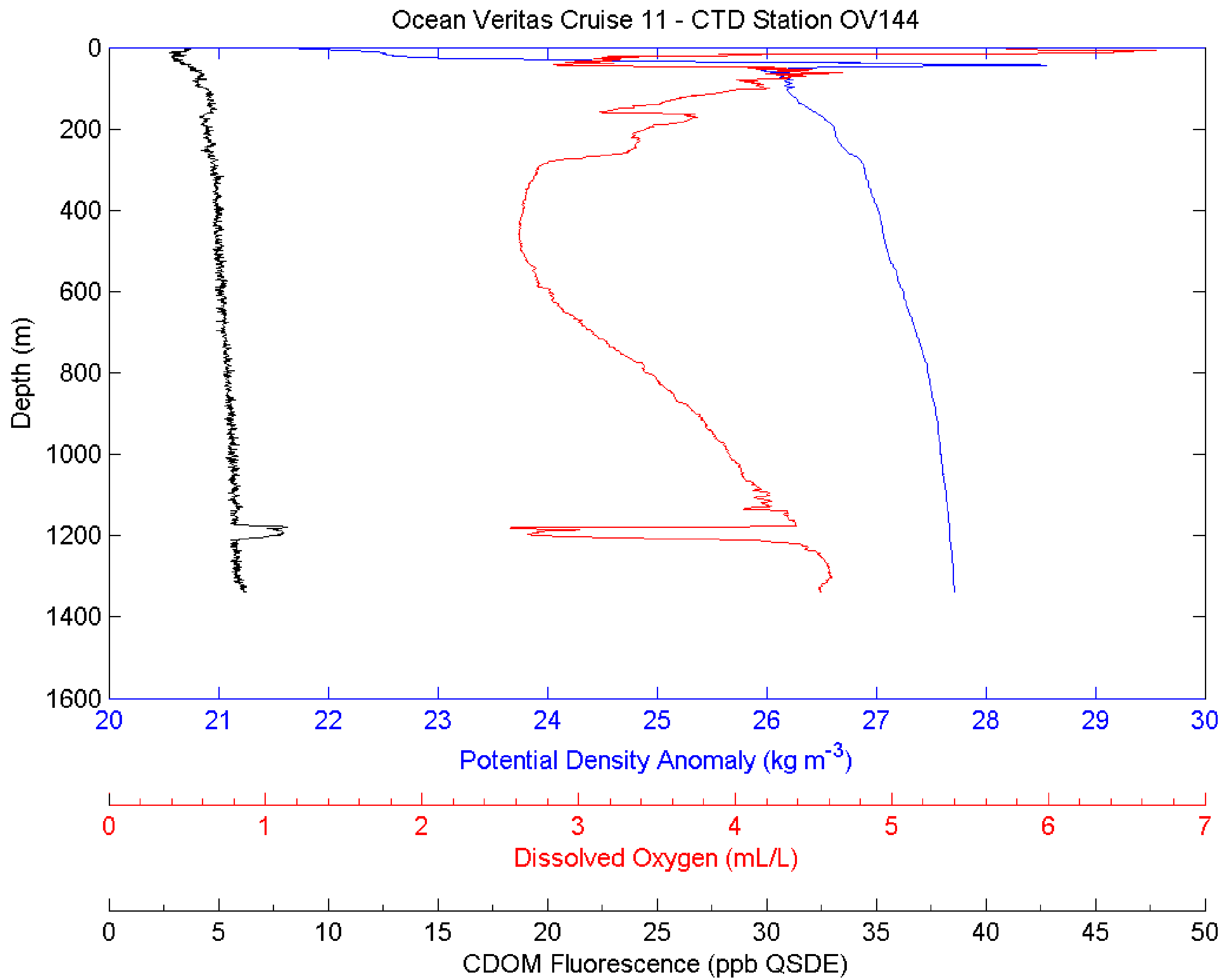
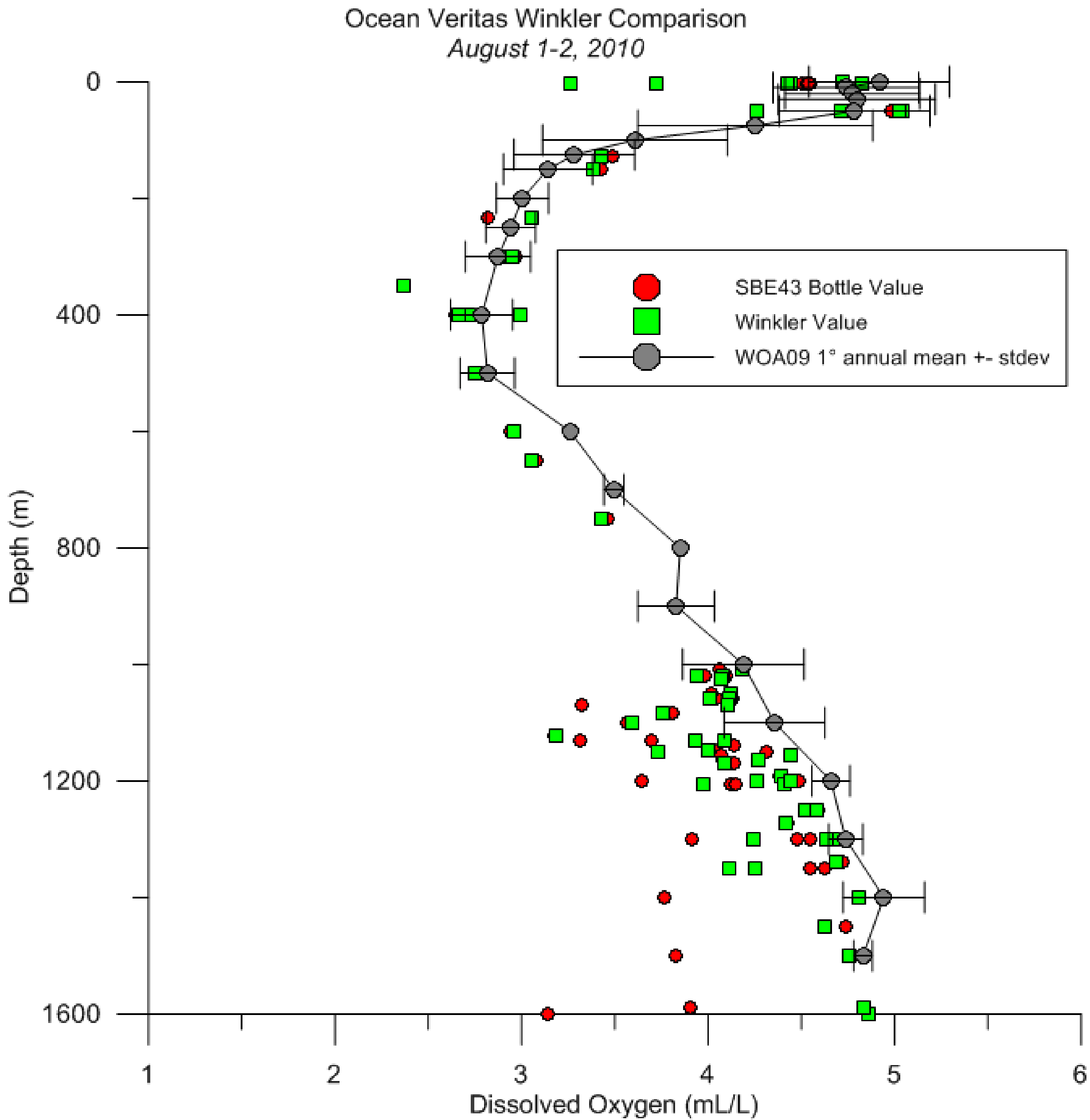
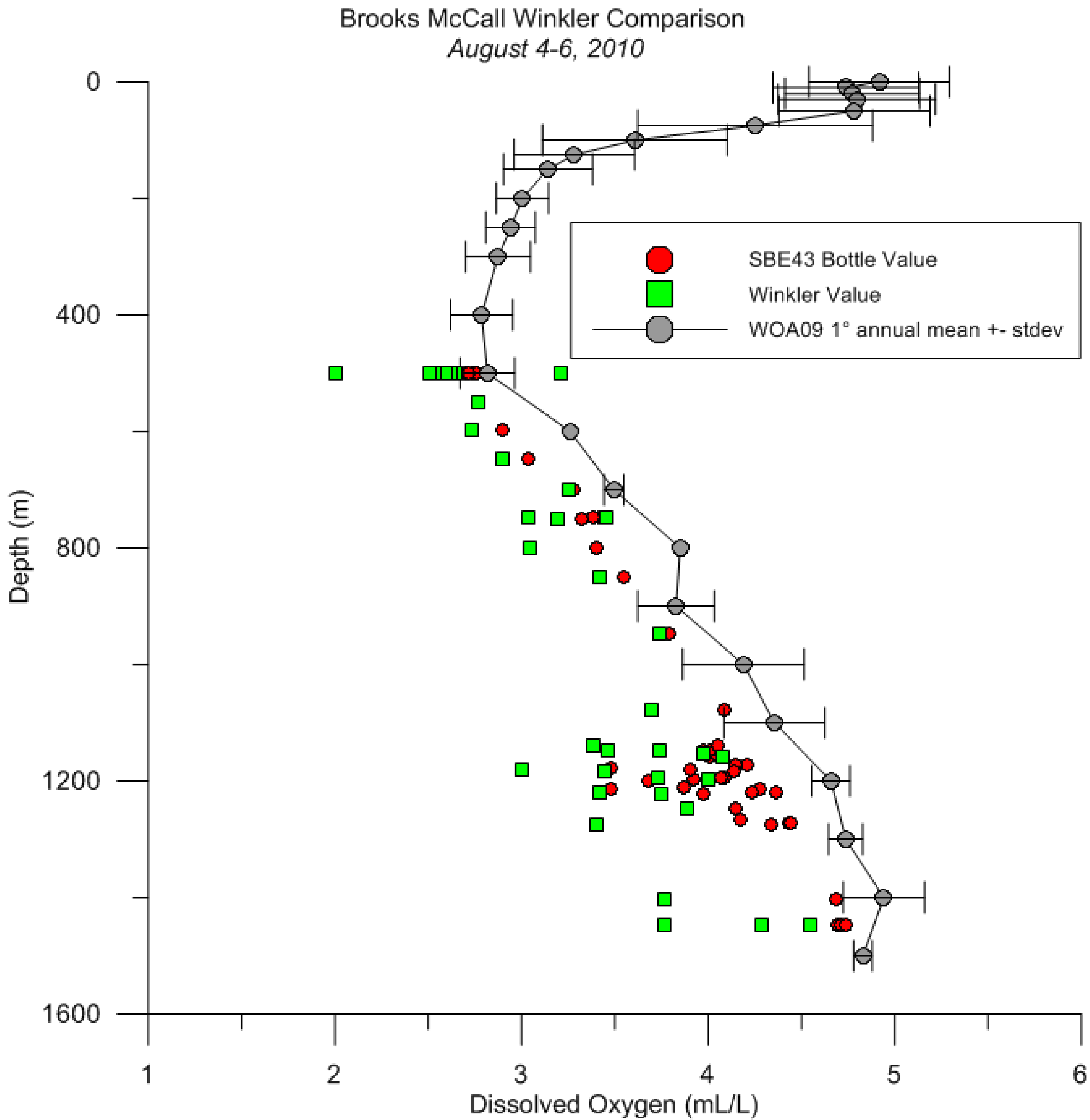


Figure 9. SBE 43 dissolved oxygen values compared to Winkler chemical titrations and the climatological mean for R/V *Ocean Veritas* data collected August 1-2.



Preliminary Data Subject To Change

Figure 10. SBE 43 dissolved oxygen values compared to Winkler chemical titrations and the climatological mean for R/V *Brooks McCall* data collected August 4-6.



Preliminary Data Subject To Change

Figure 11. Raw CDOM fluorescence, dissolved oxygen, temperature and salinity profiles for R/V *Ferrel* Station TN09-SS01, the last station where a fluorescence anomaly was observed.

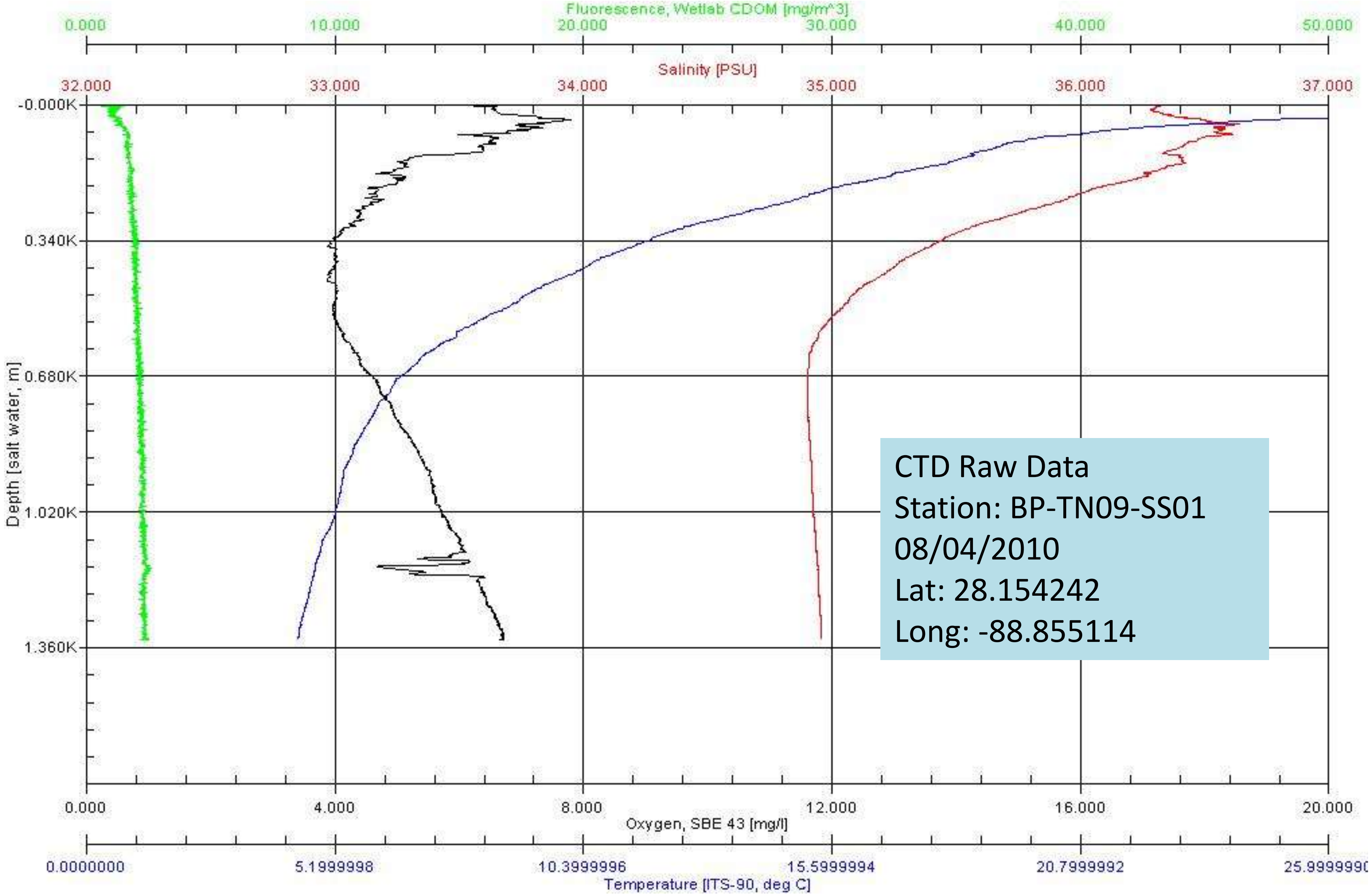


Figure 12. Current direction and velocity measured every 10 minutes at 1166 m depth near the wellhead from May 1 to July 30.

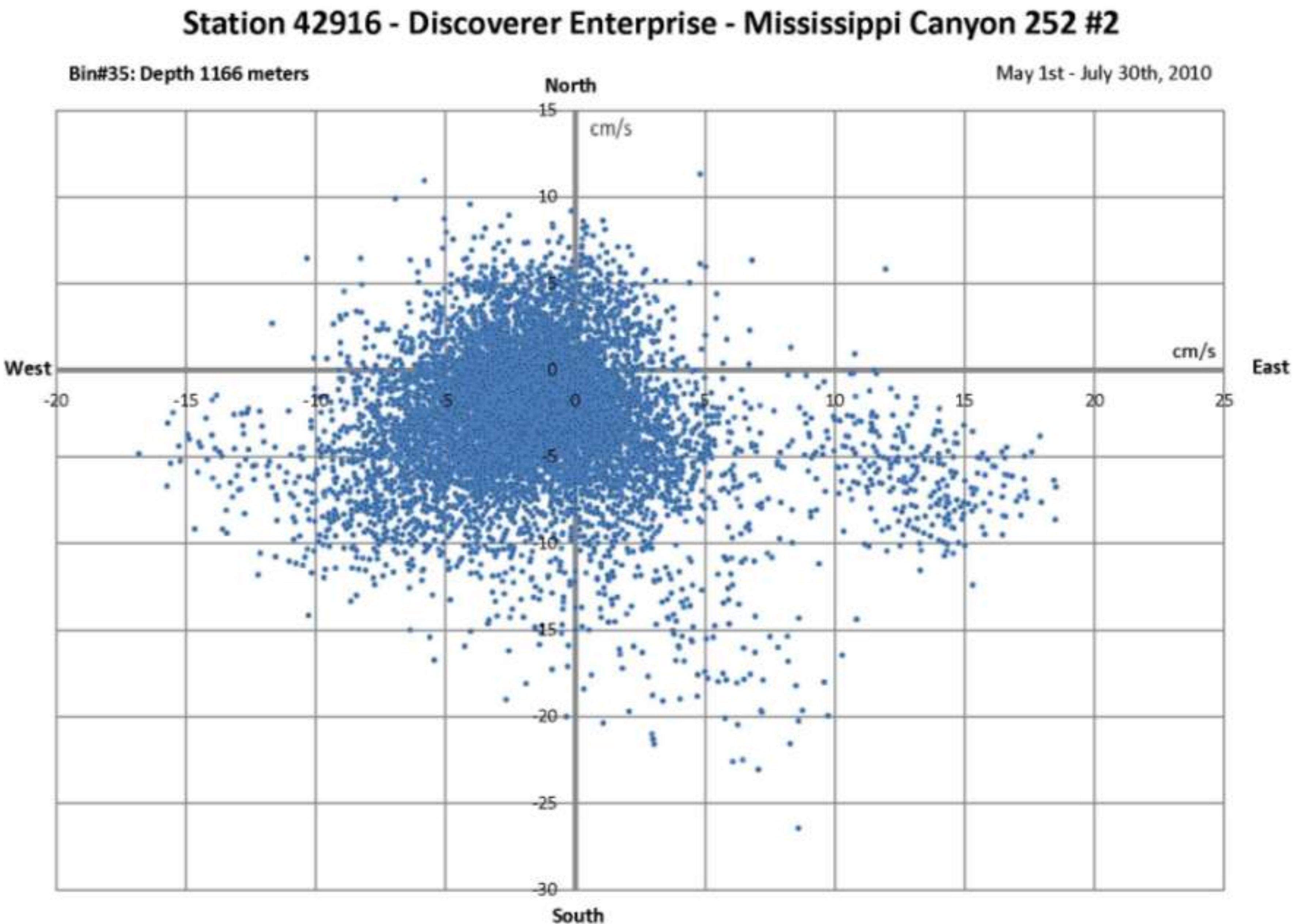


Figure 13. Normalized CDOM fluorescence plotted against potential water density showing close correspondence with a water layer having a density between 27.70 and 27.71.

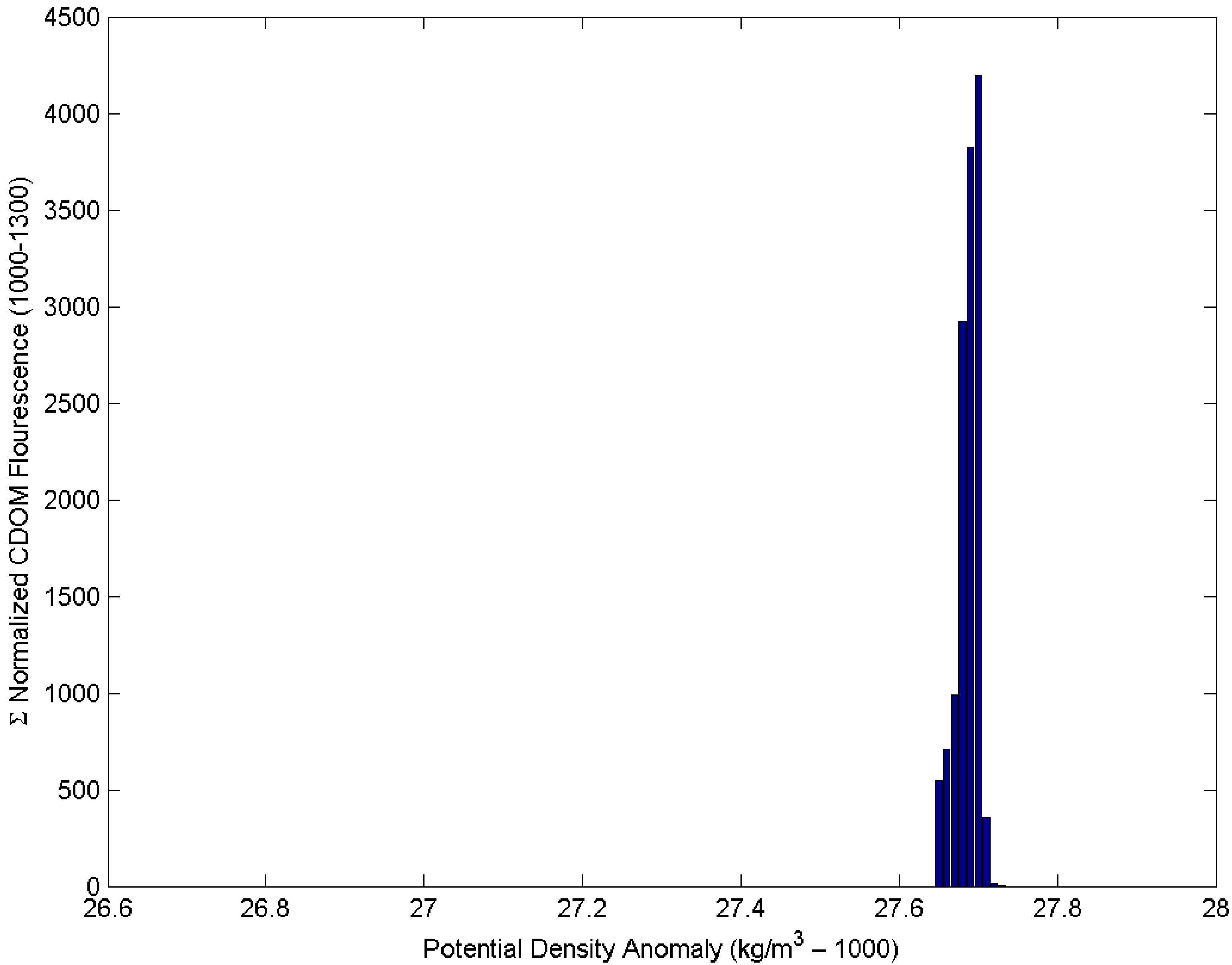
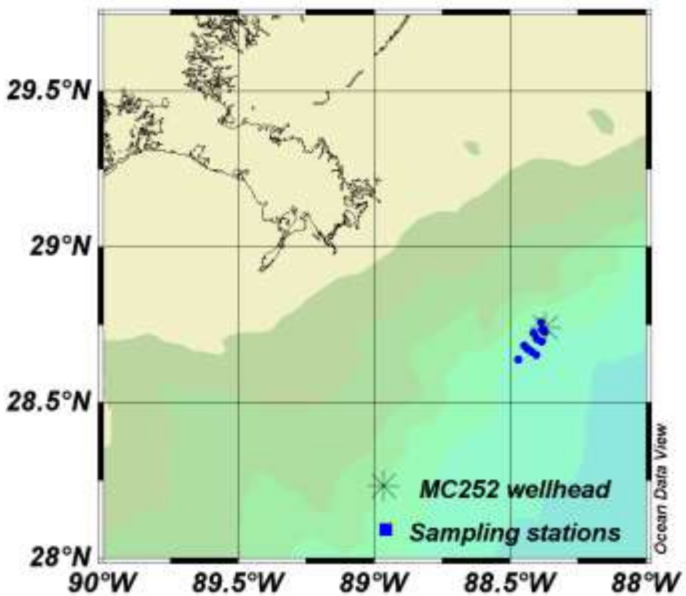
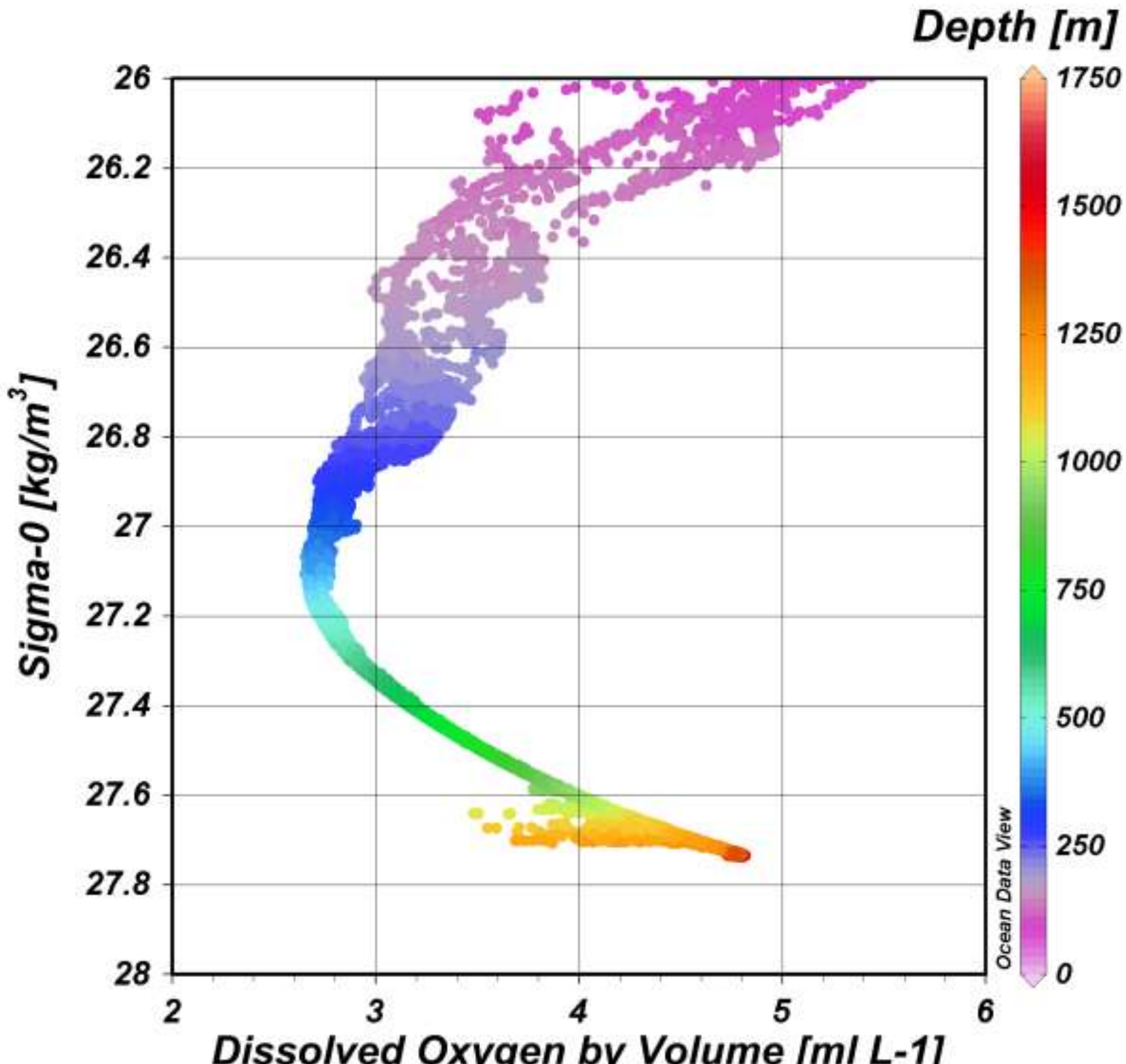


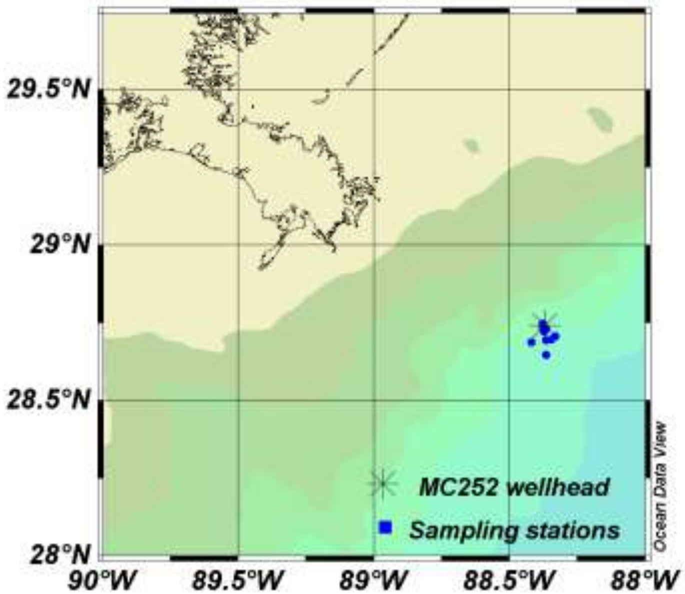
Figure 14. SBE 43 DO_2 measurements for R/V *Brooks McCall* cruise 5. Figure shows DO_2 concentrations as a function of Sigma theta and depth and the geographic location of stations.

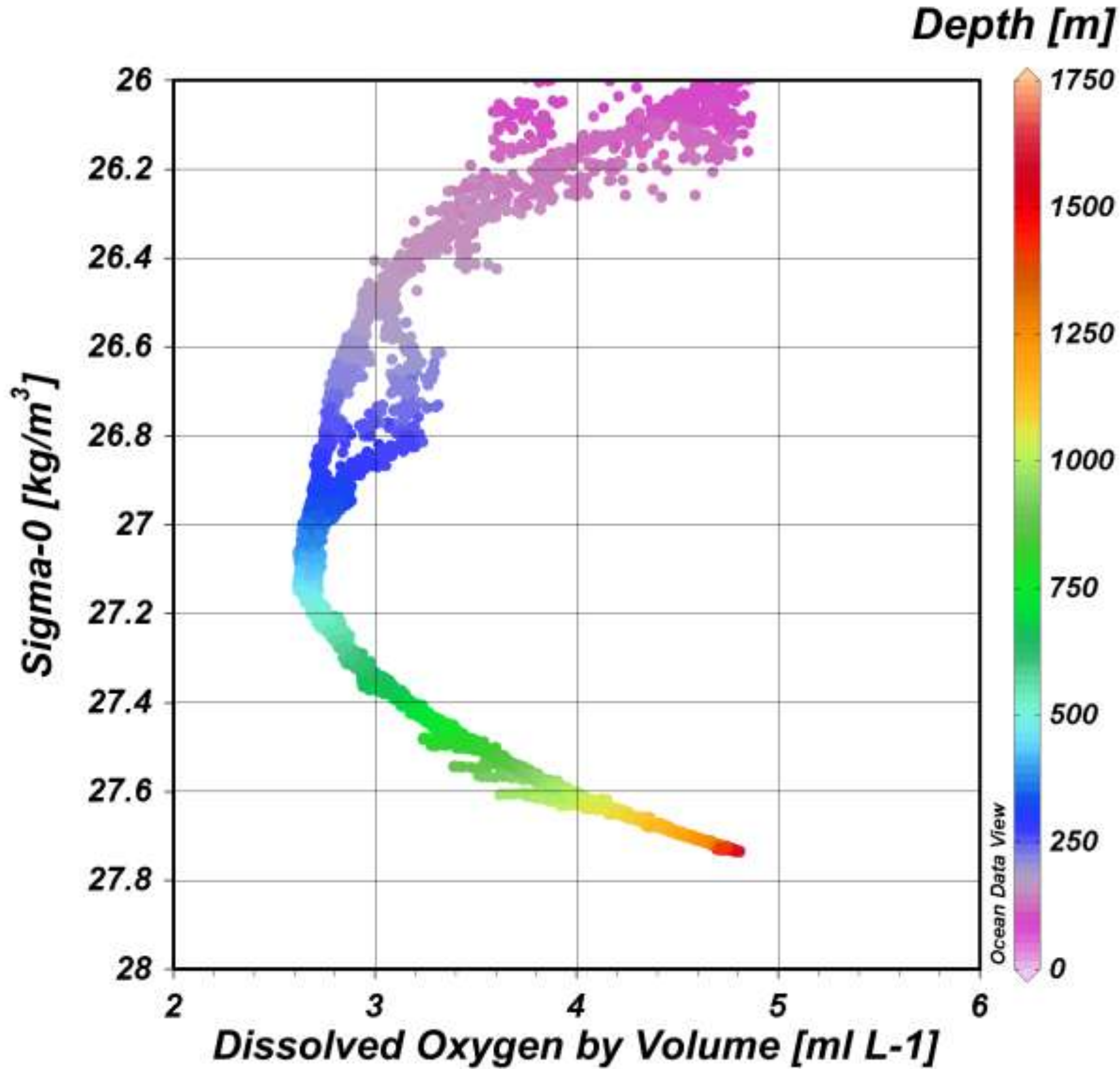




Preliminary Data Subject To Change

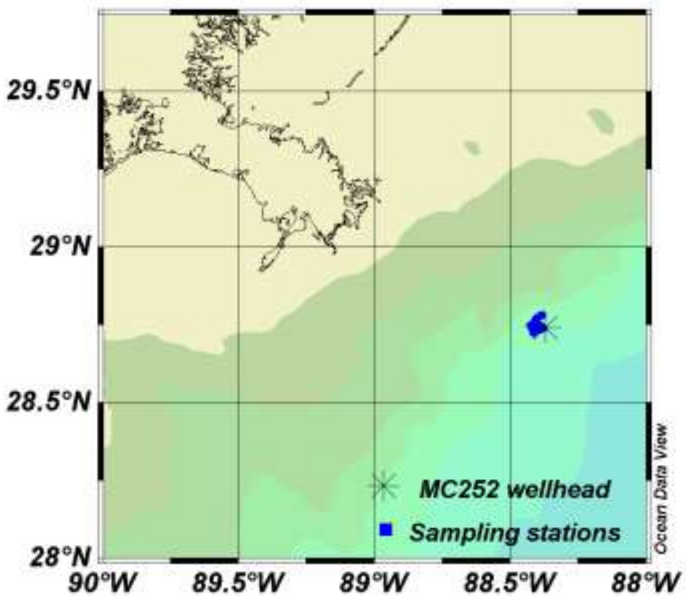
Figure 15. SBE 43 DO_2 measurements for R/V *Brooks McCall* cruise 6. Figure shows DO_2 concentrations as a function of Sigma theta and depth and the geographic location of stations.

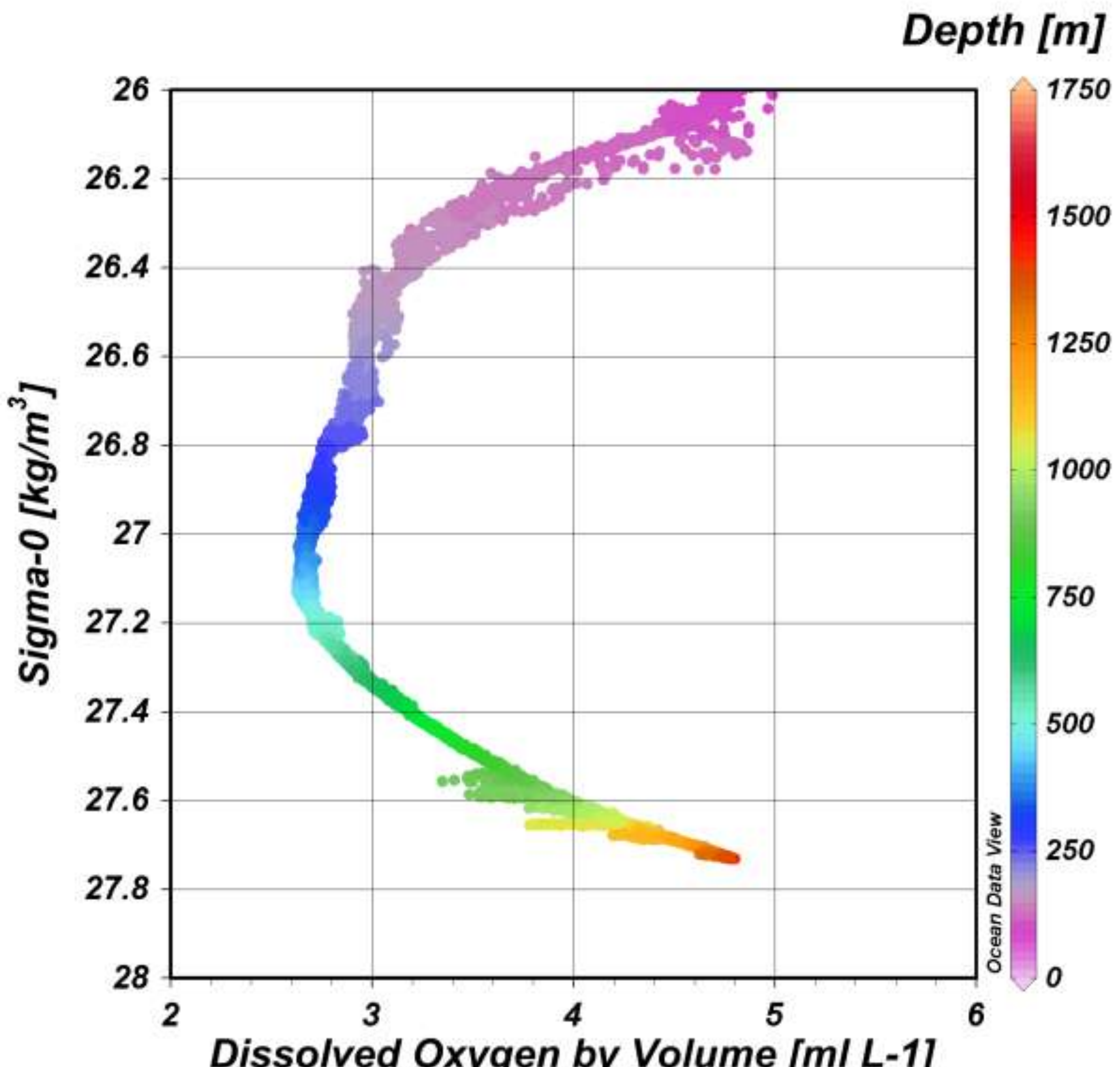




Preliminary Data Subject To Change

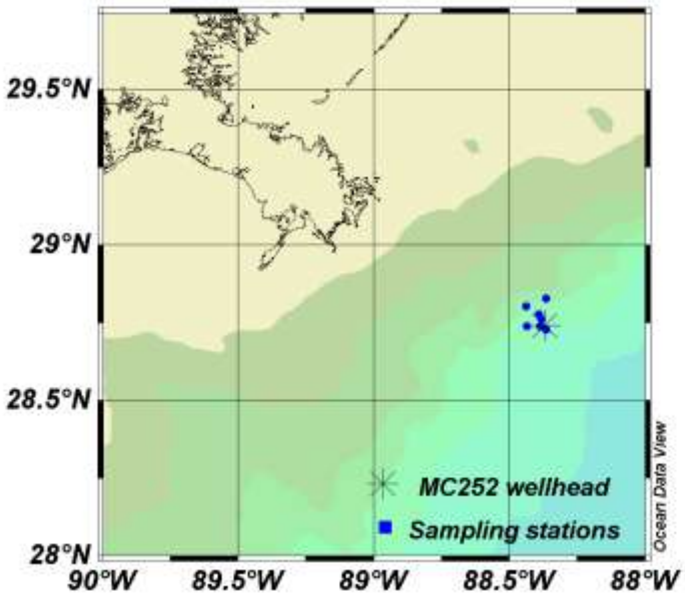
Figure 16. SBE 43 DO_2 measurements for R/V *Brooks McCall* cruise 7. Figure shows DO_2 concentrations as a function of Sigma theta and depth and the geographic location of stations.

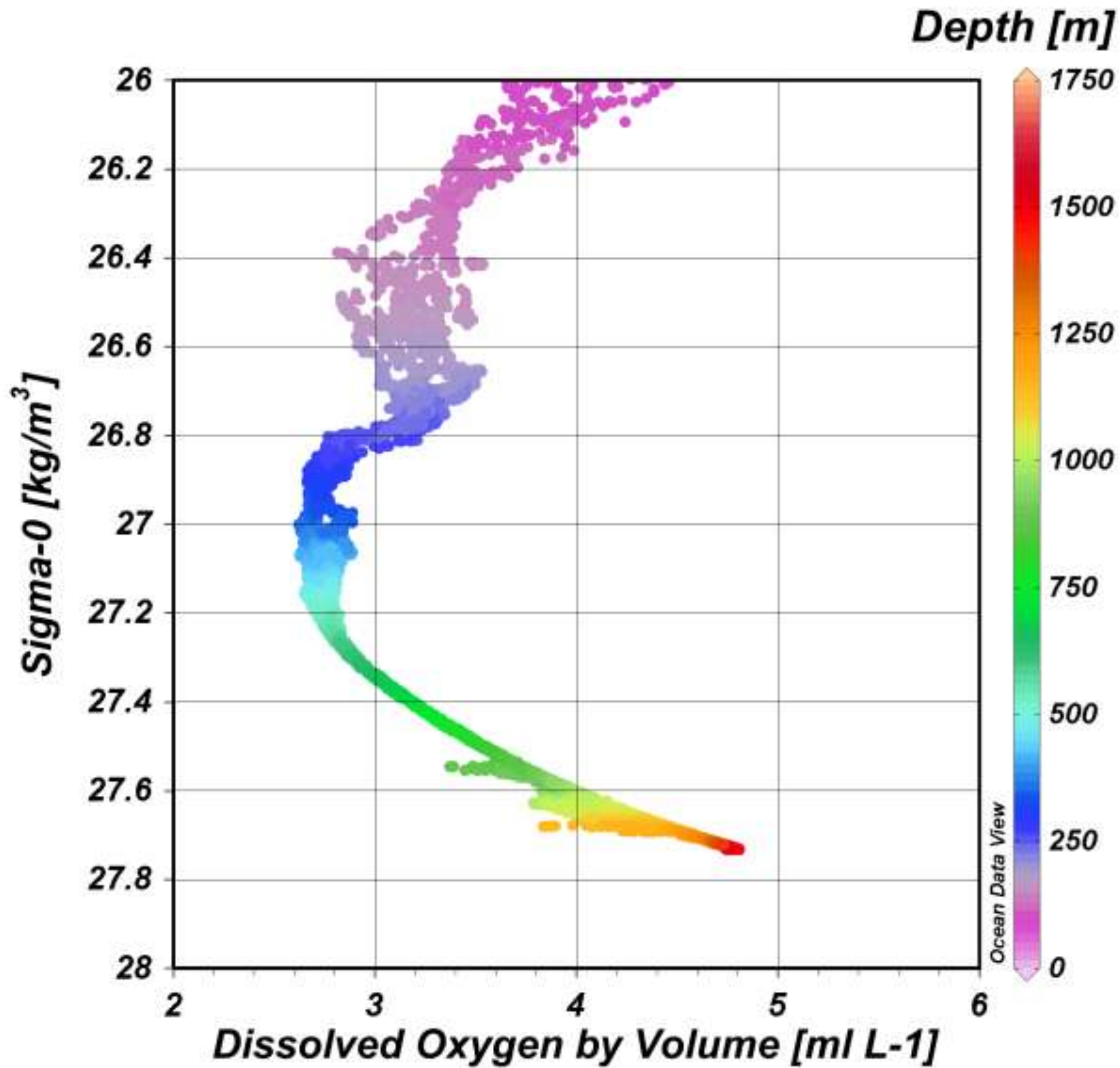




Preliminary Data Subject To Change

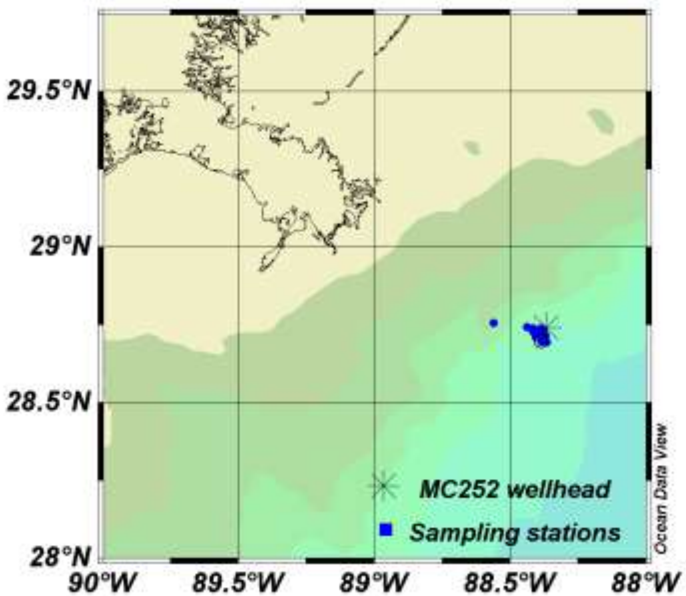
Figure 17. SBE 43 DO_2 measurements for R/V *Brooks McCall* cruise 8. Figure shows DO_2 concentrations as a function of Sigma theta and depth and the geographic location of stations.





Preliminary Data Subject To Change

Figure 18. SBE 43 DO_2 measurements for R/V *Brooks McCall* cruise 9. Figure shows DO_2 concentrations as a function of Sigma theta and depth and the geographic location of stations.



Preliminary Data Subject To Change

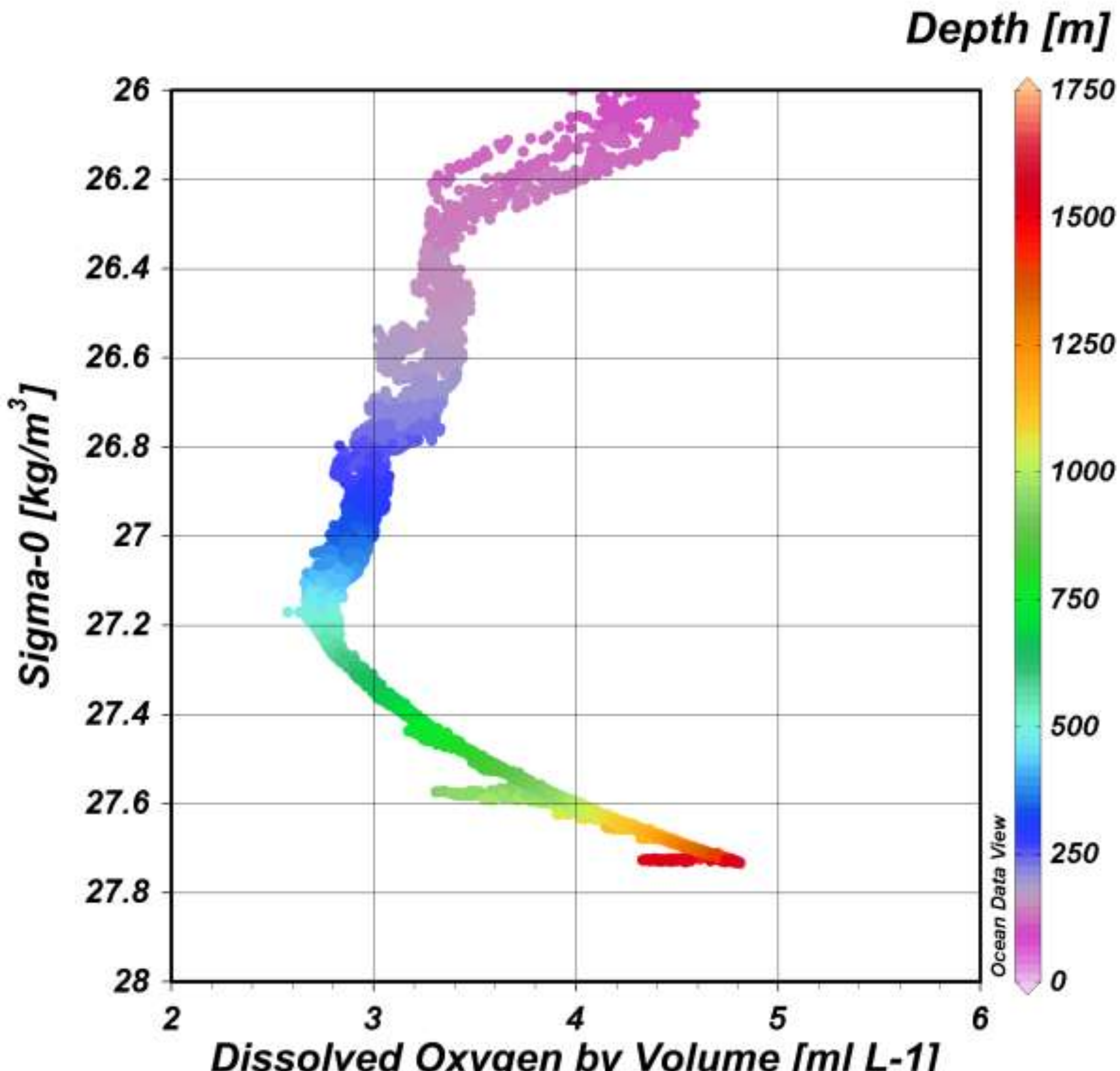
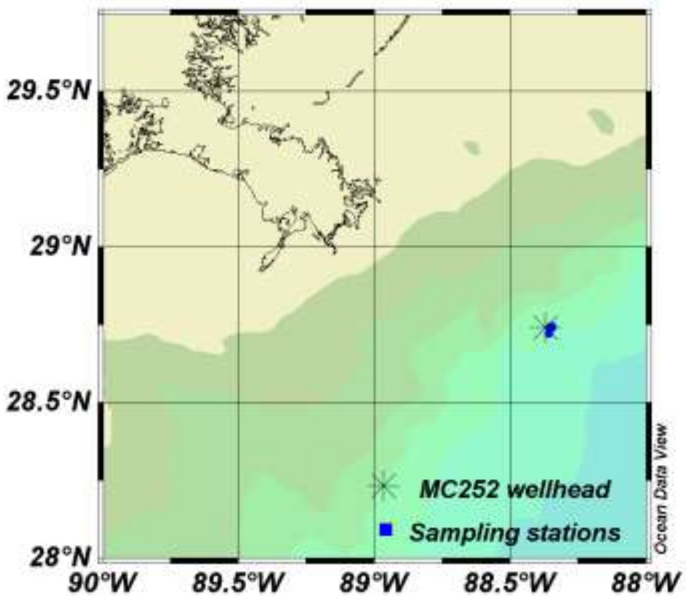


Figure 19. SBE 43 DO_2 measurements for R/V *Brooks McCall* cruise 11. Figure shows DO_2 concentrations as a function of Sigma theta and depth and the geographic location of stations.



Preliminary Data Subject To Change

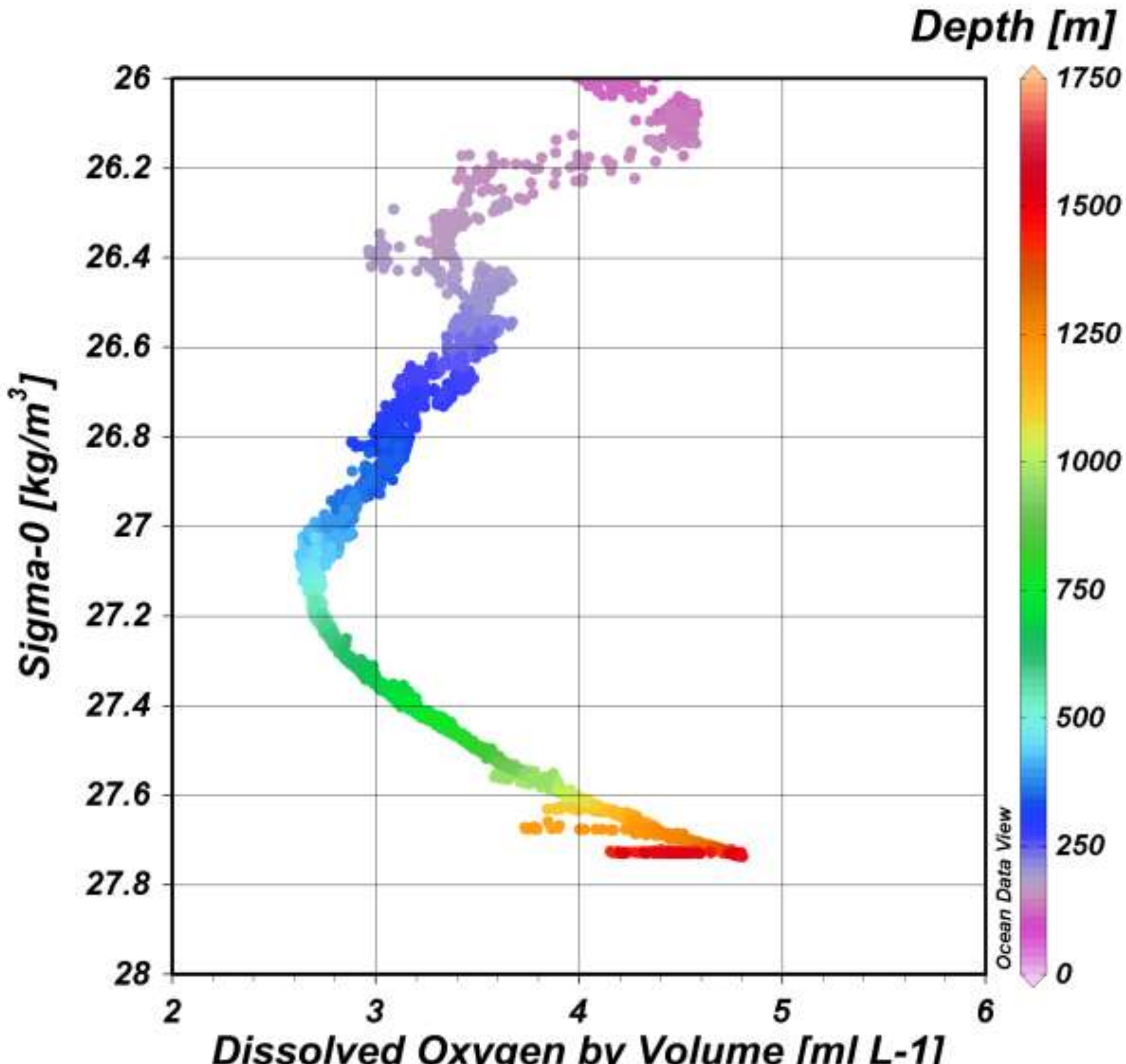
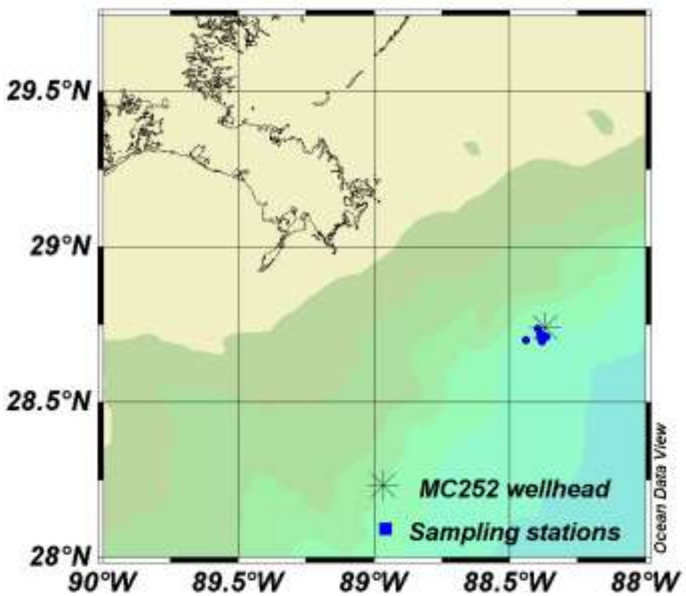
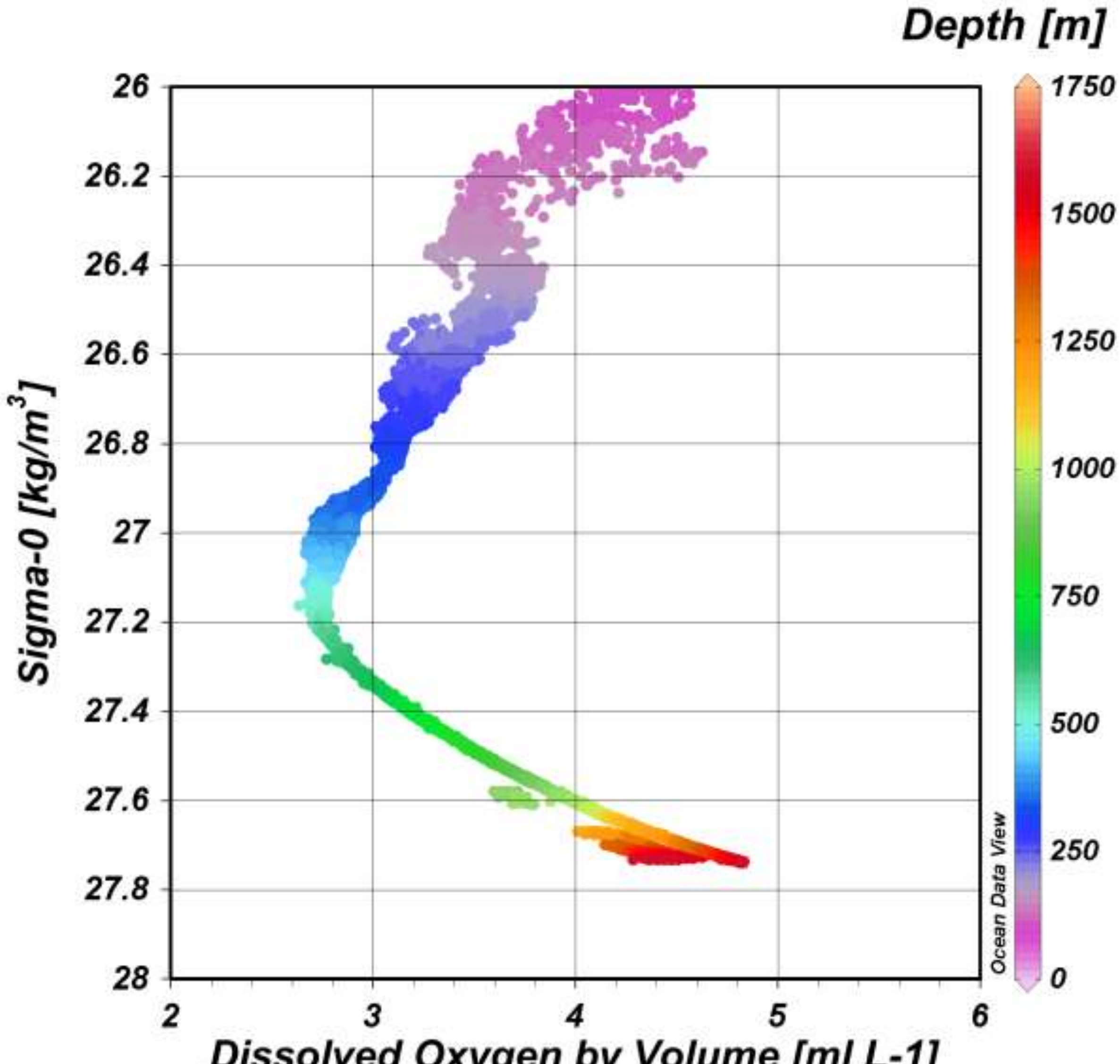


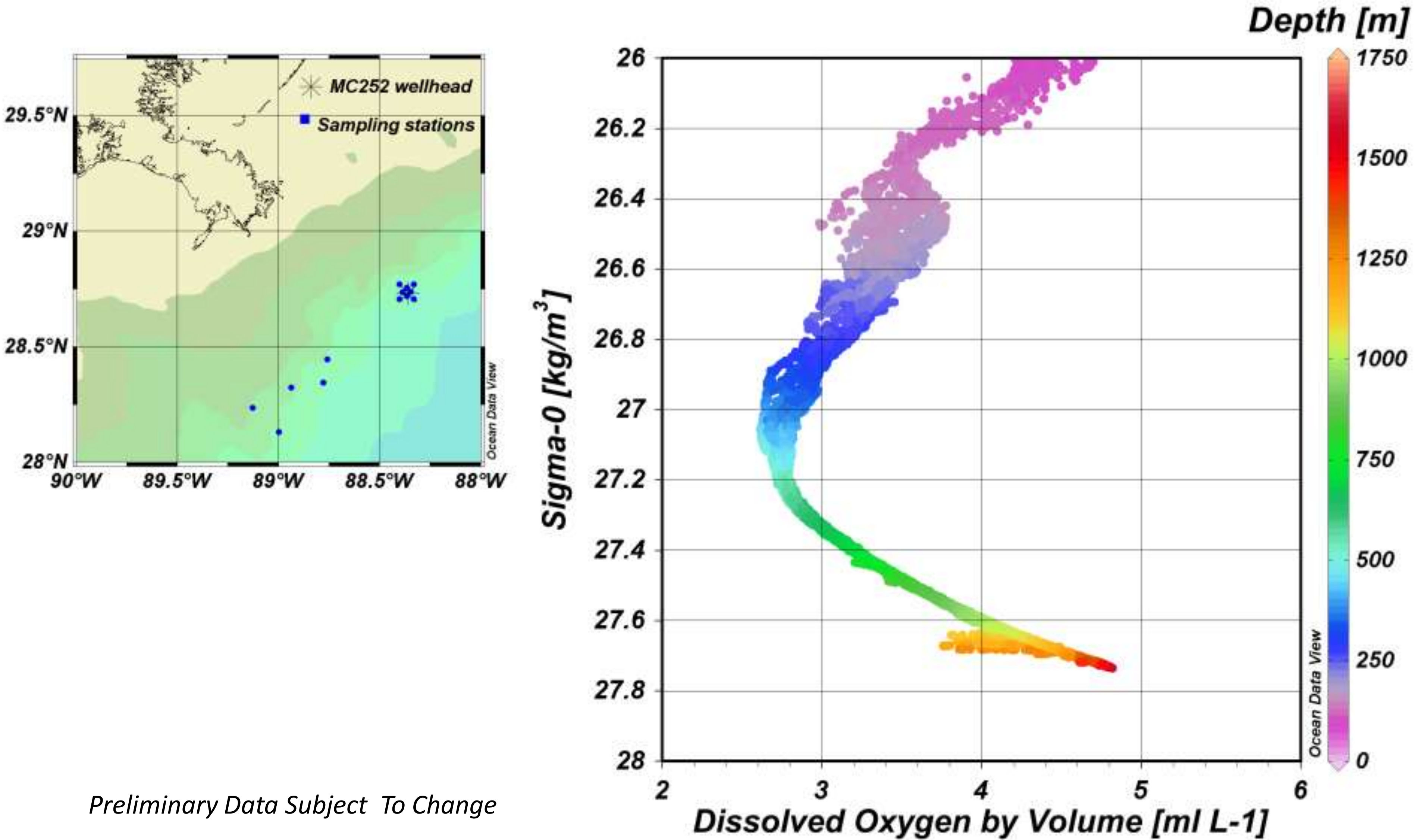
Figure 20. SBE 43 DO_2 measurements for R/V *Brooks McCall* cruise 12. Figure shows DO_2 concentrations as a function of Sigma theta and depth and the geographic location of stations.





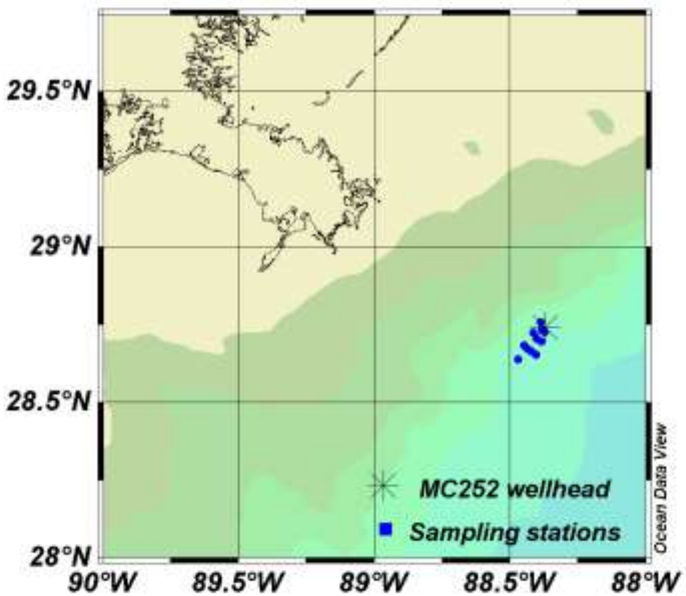
Preliminary Data Subject To Change

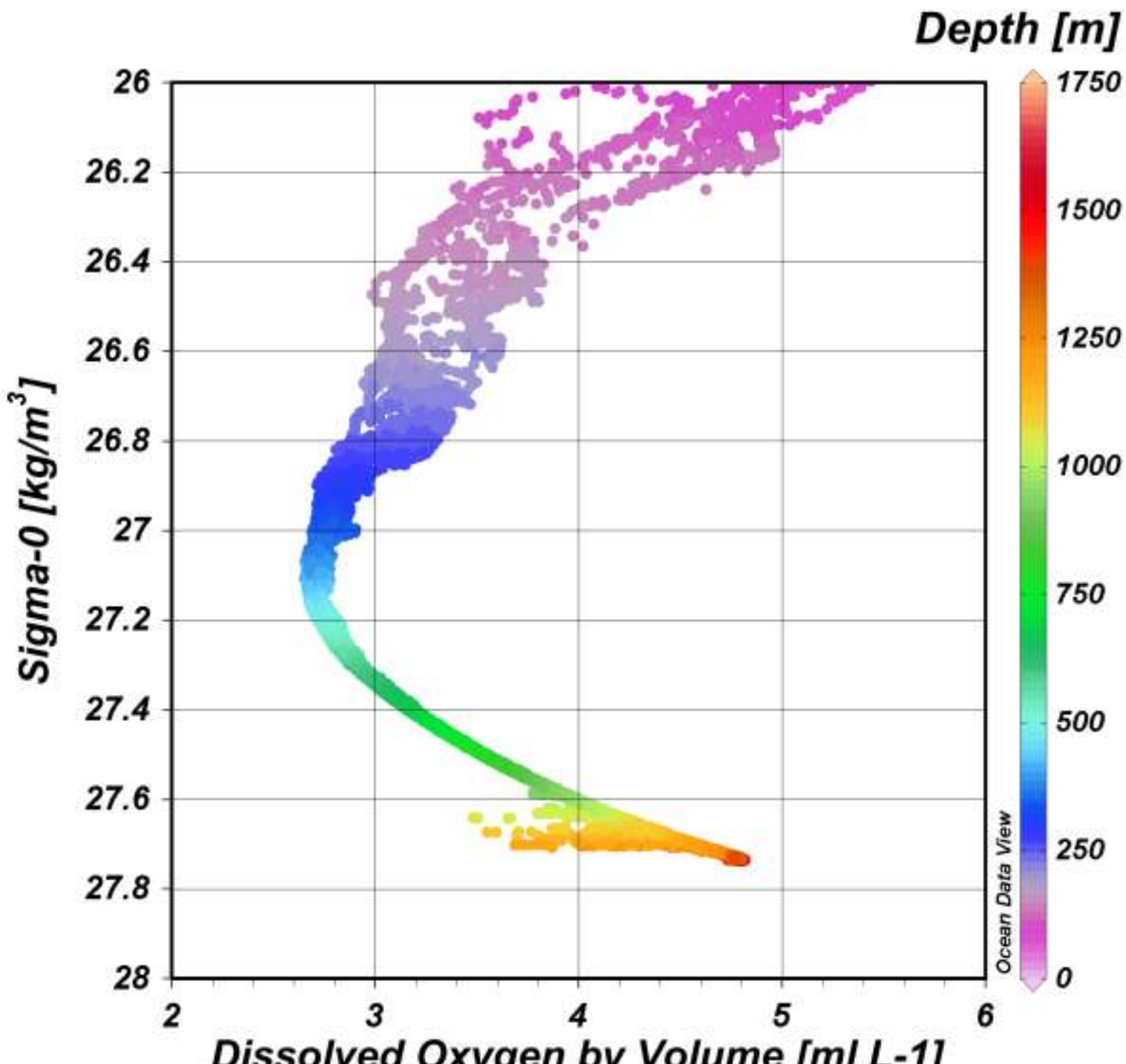
Figure 21. SBE 43 DO_2 measurements for R/V *Brooks McCall* cruise 15. Figure shows DO_2 concentrations as a function of Sigma theta and depth and the geographic location of stations.



Preliminary Data Subject To Change

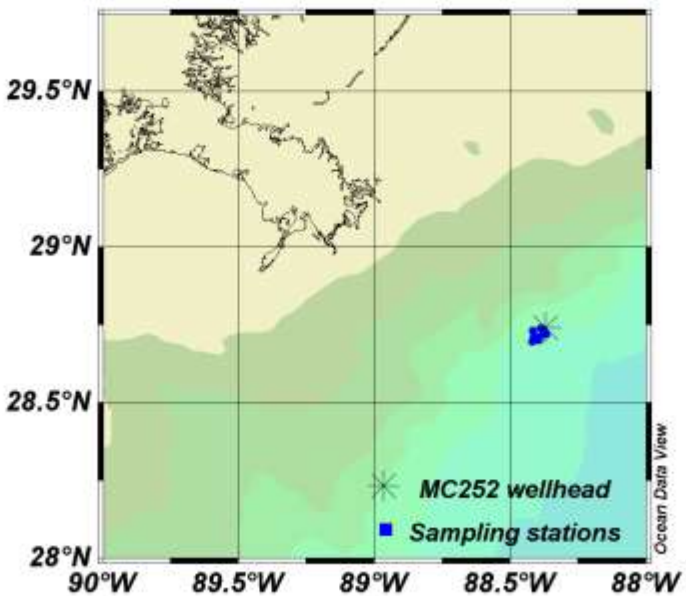
Figure 22. SBE 43 DO_2 measurements for R/V *Ocean Veritas* cruise 5. Figure shows DO_2 concentrations as a function of Sigma theta and depth and the geographic location of stations.

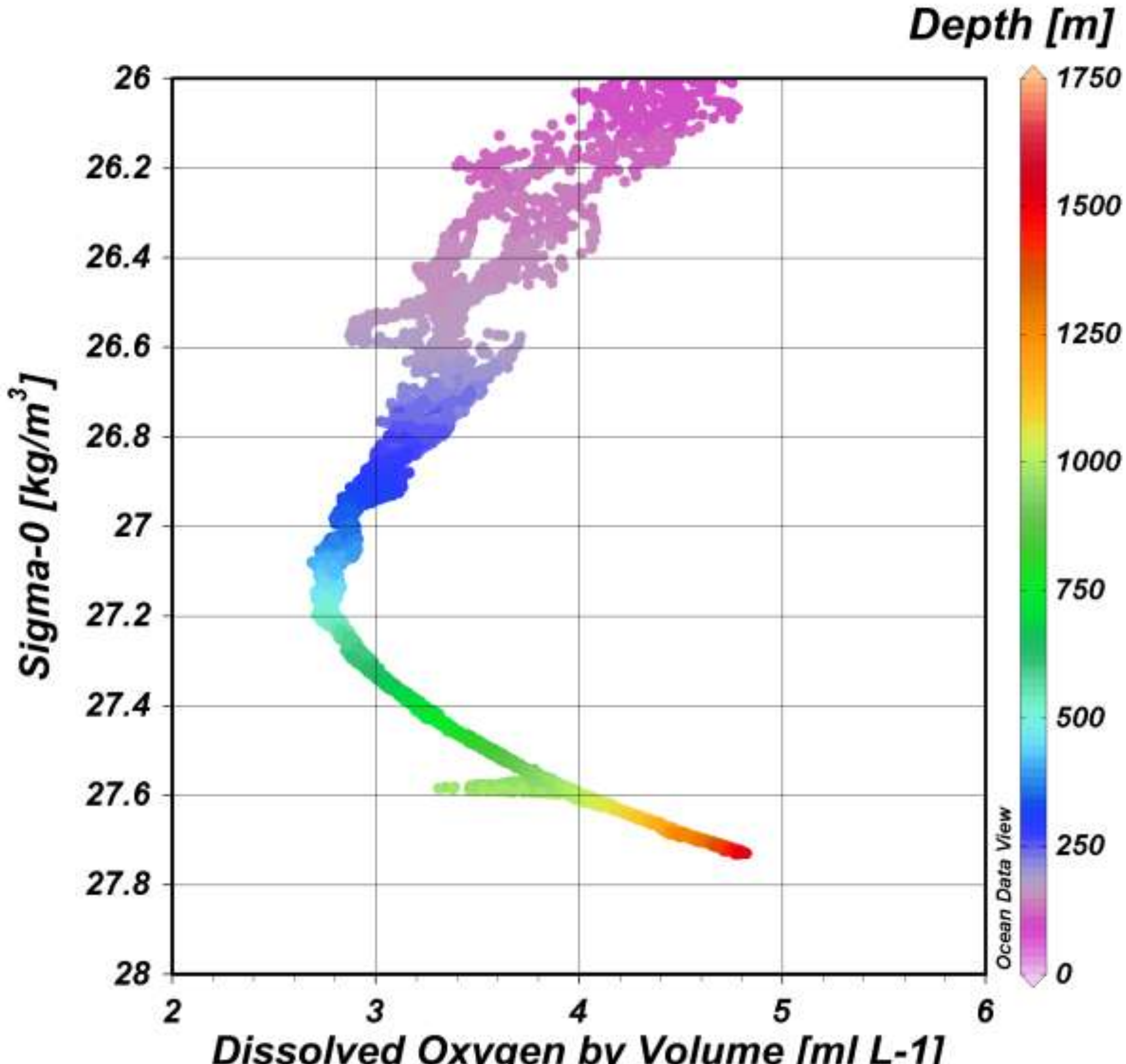




Preliminary Data Subject To Change

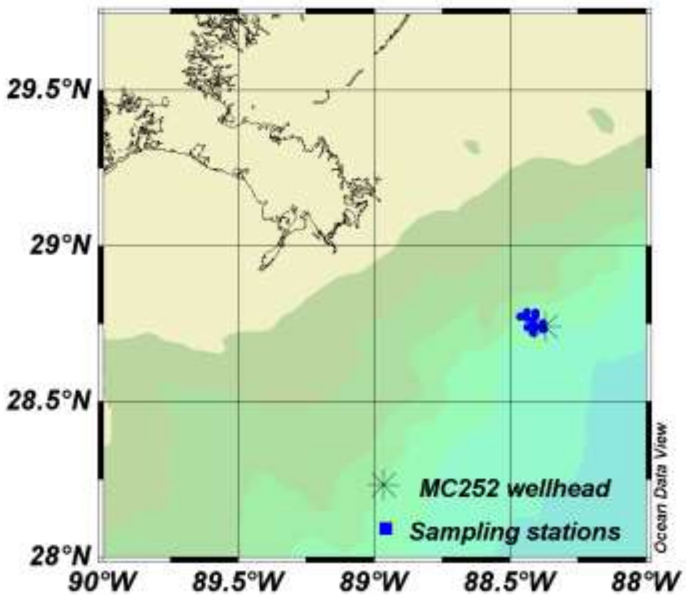
Figure 23. SBE 43 DO_2 measurements for R/V *Ocean Veritas* cruise 6. Figure shows DO_2 concentrations as a function of Sigma theta and depth and the geographic location of stations.





Preliminary Data Subject To Change

Figure 24. SBE 43 DO_2 measurements for R/V *Ocean Veritas* cruise 7. Figure shows DO_2 concentrations as a function of Sigma theta and depth and the geographic location of stations.



Preliminary Data Subject To Change

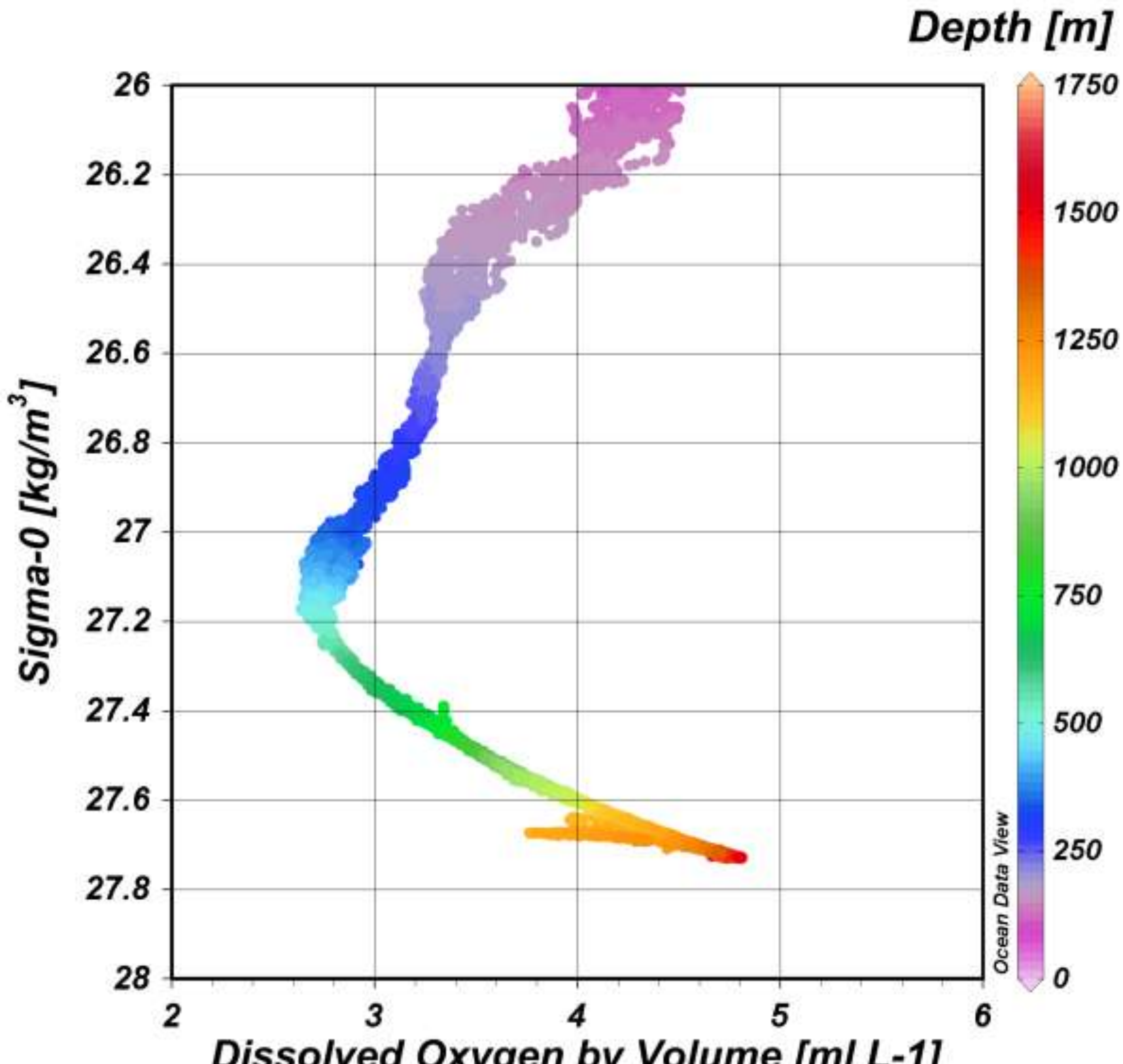
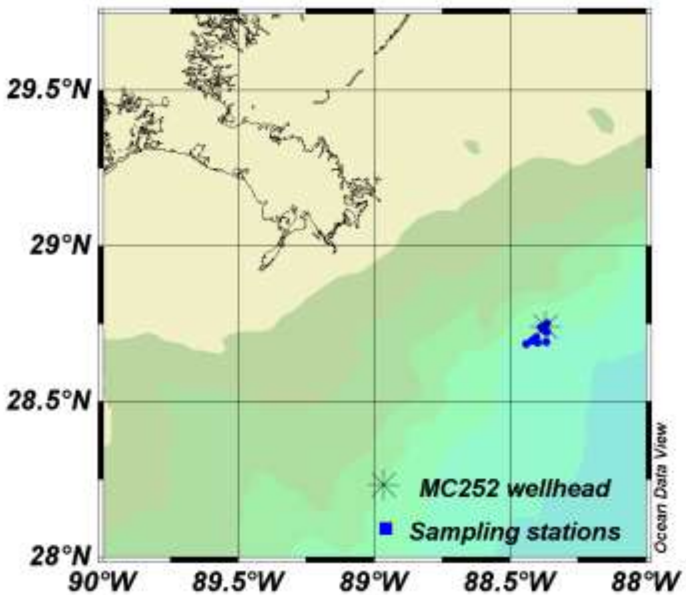
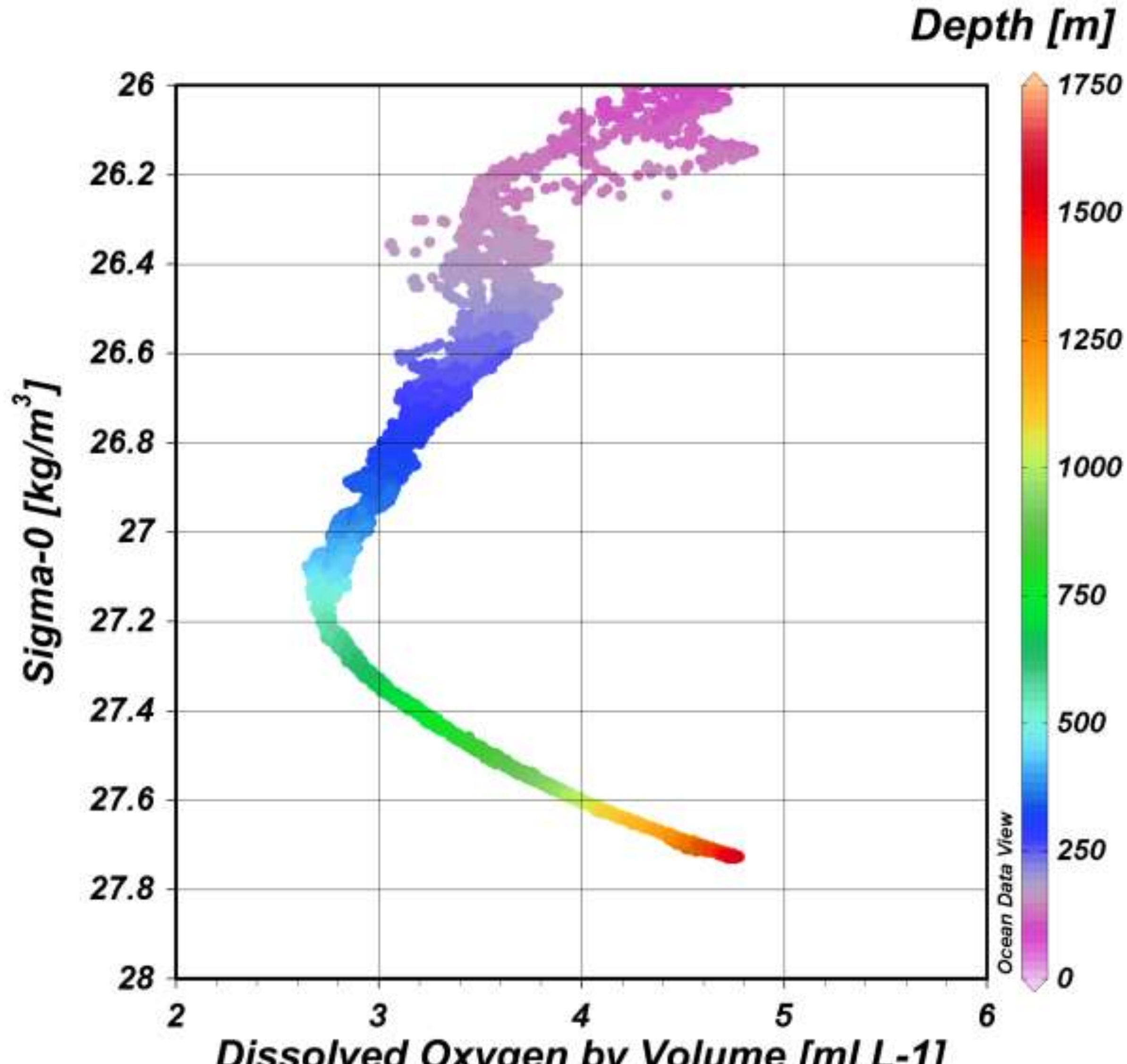


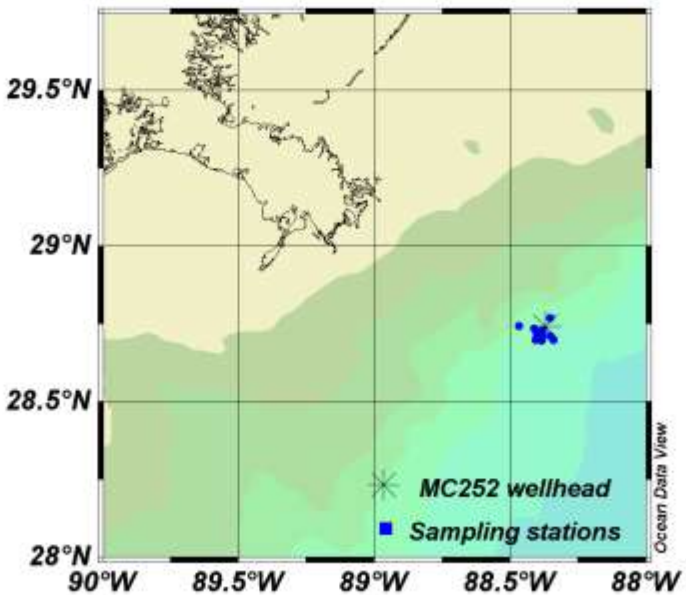
Figure 25. SBE 43 DO_2 measurements for R/V *Ocean Veritas* cruise 8. Figure shows DO_2 concentrations as a function of Sigma theta and depth and the geographic location of stations.

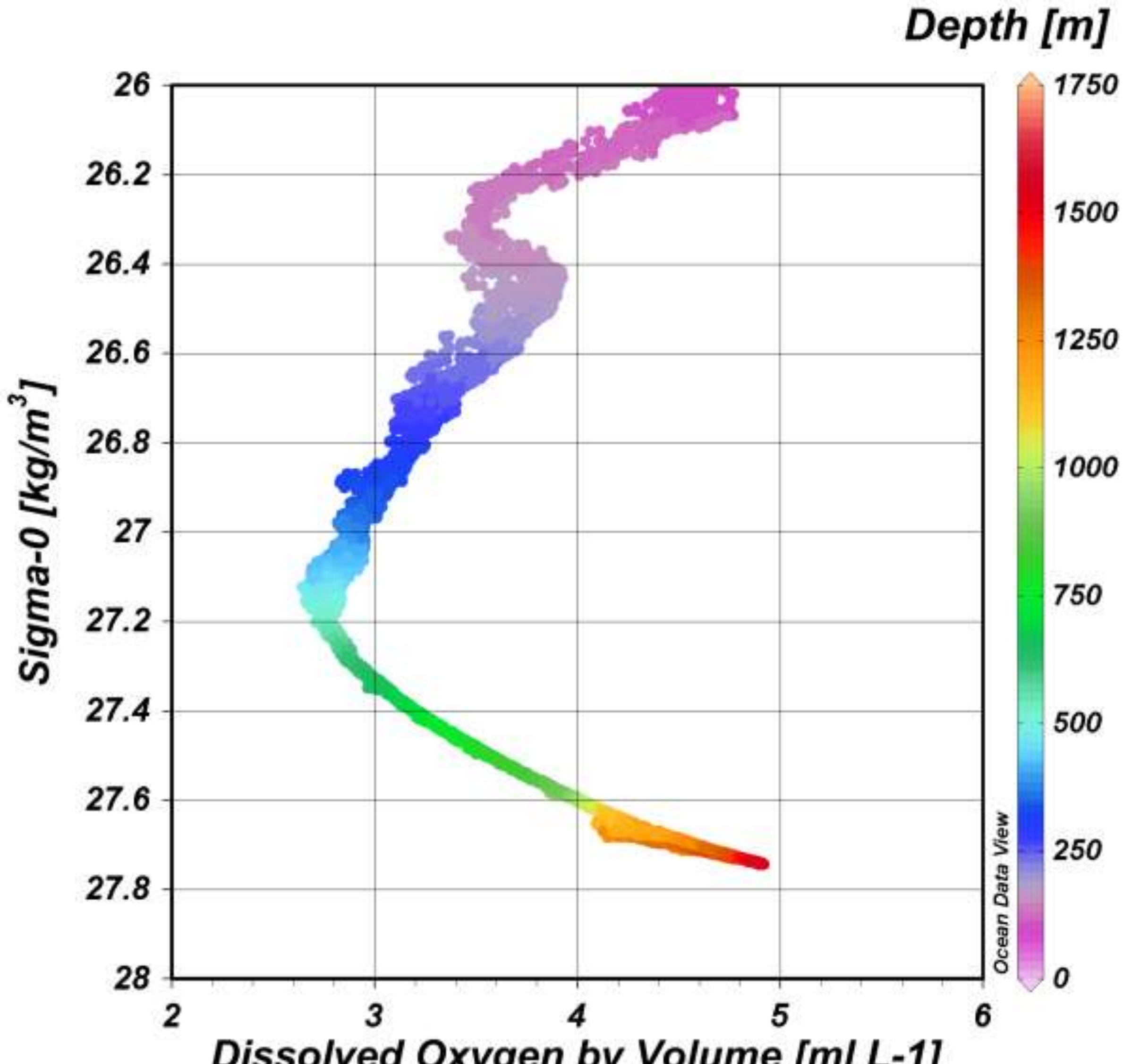




Preliminary Data Subject To Change

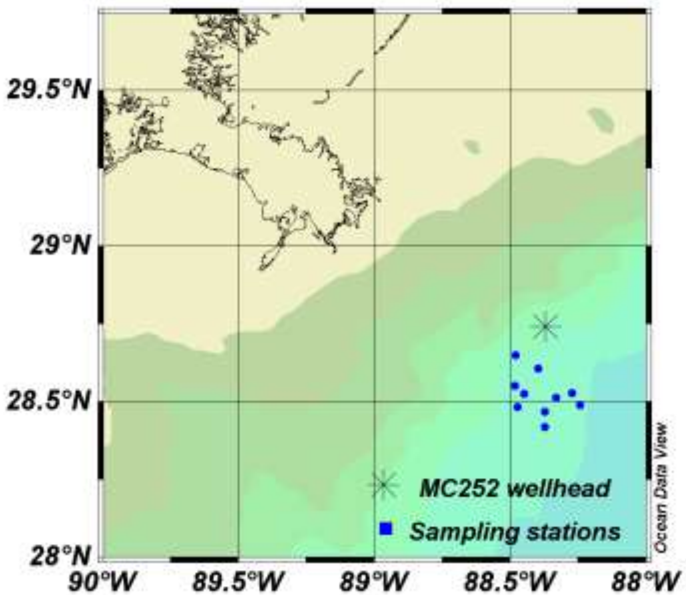
Figure 26. SBE 43 DO_2 measurements for R/V *Ocean Veritas* cruise 9. Figure shows DO_2 concentrations as a function of Sigma theta and depth and the geographic location of stations.

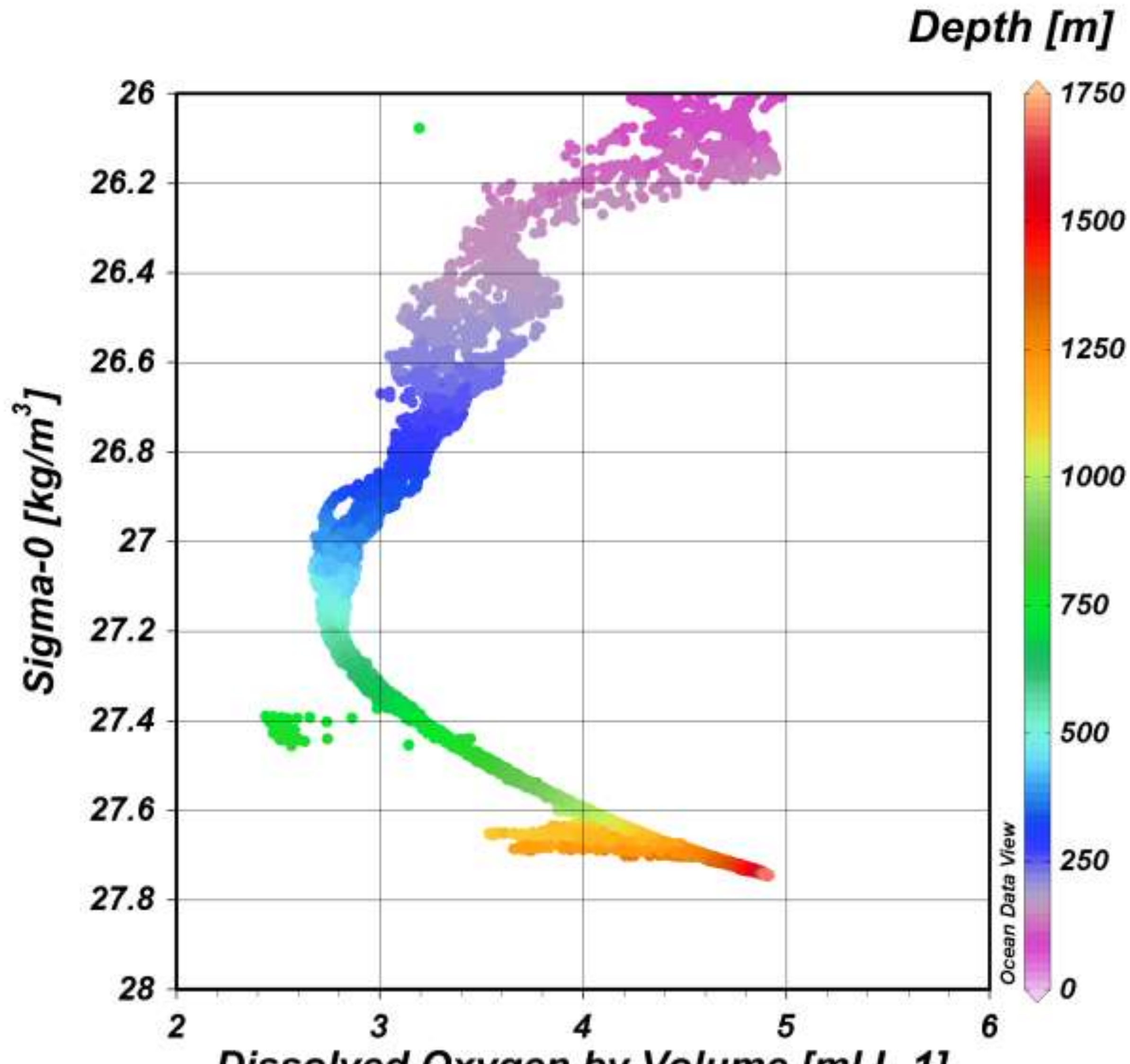




Preliminary Data Subject To Change

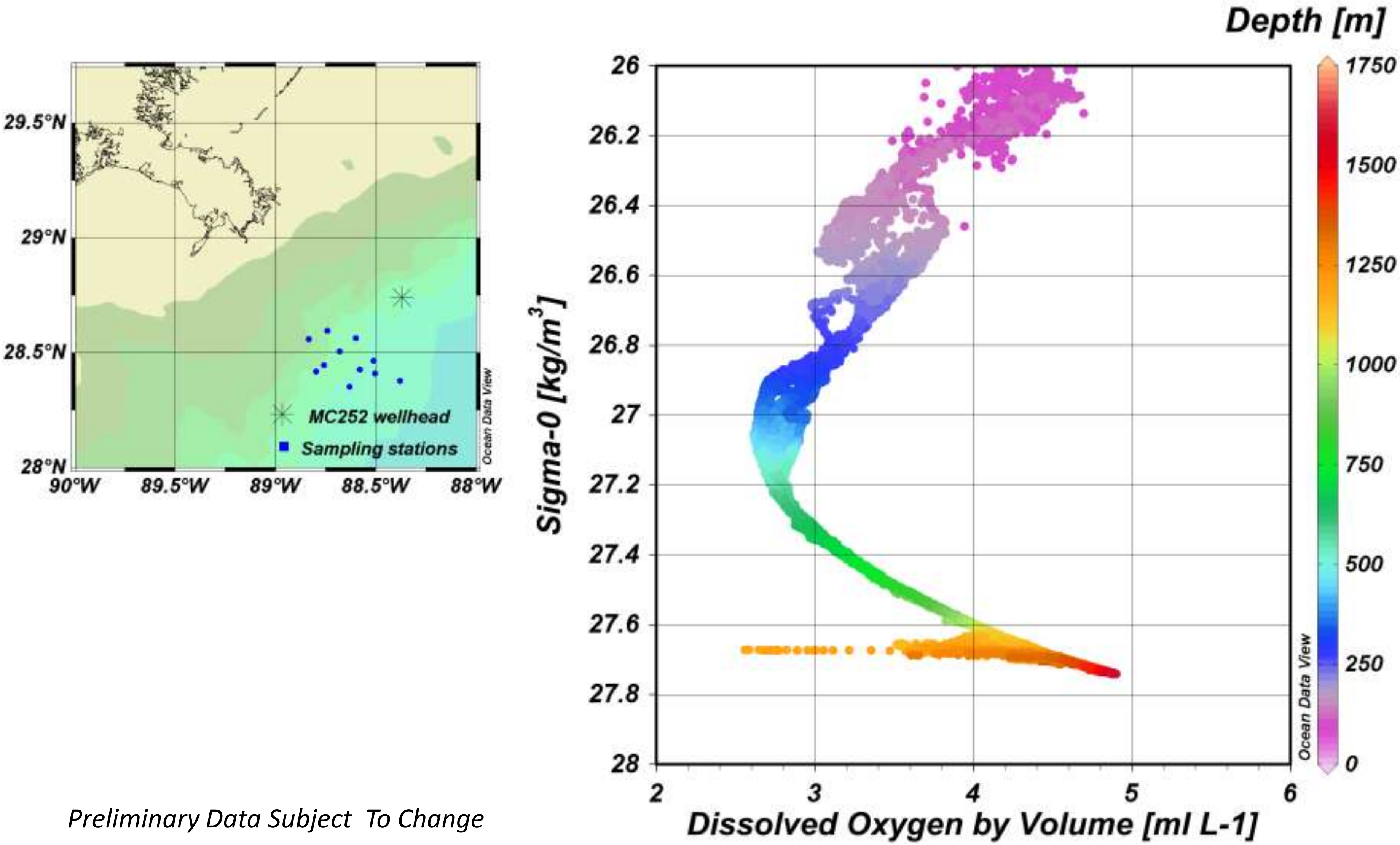
Figure 27. SBE 43 DO_2 measurements for R/V *Ocean Veritas* cruise 10. Figure shows DO_2 concentrations as a function of Sigma theta and depth and the geographic location of stations.





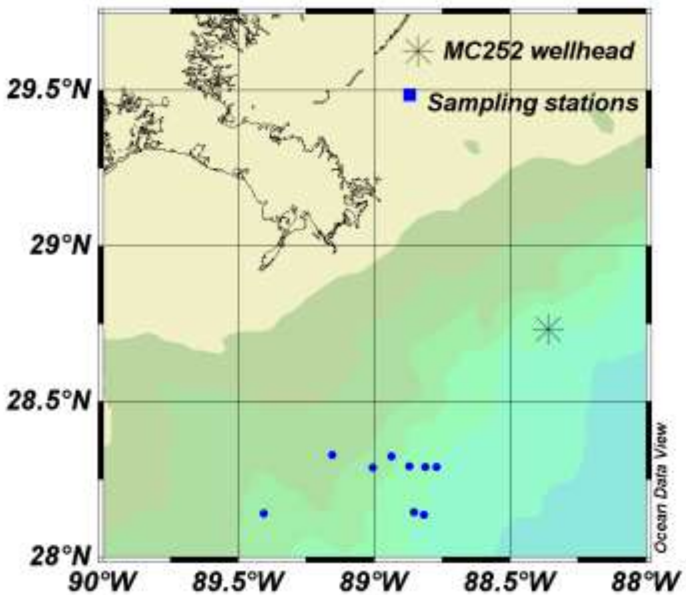
Preliminary Data Subject To Change

Figure 28. SBE 43 DO_2 measurements for R/V *Ocean Veritas* cruise 11. Figure shows DO_2 concentrations as a function of Sigma theta and depth and the geographic location of stations.



Preliminary Data Subject To Change

Figure 29. SBE 43 DO_2 measurements for R/V *Ocean Veritas* cruise 12. Figure shows DO_2 concentrations as a function of Sigma theta and depth and the geographic location of stations.



Preliminary Data Subject To Change

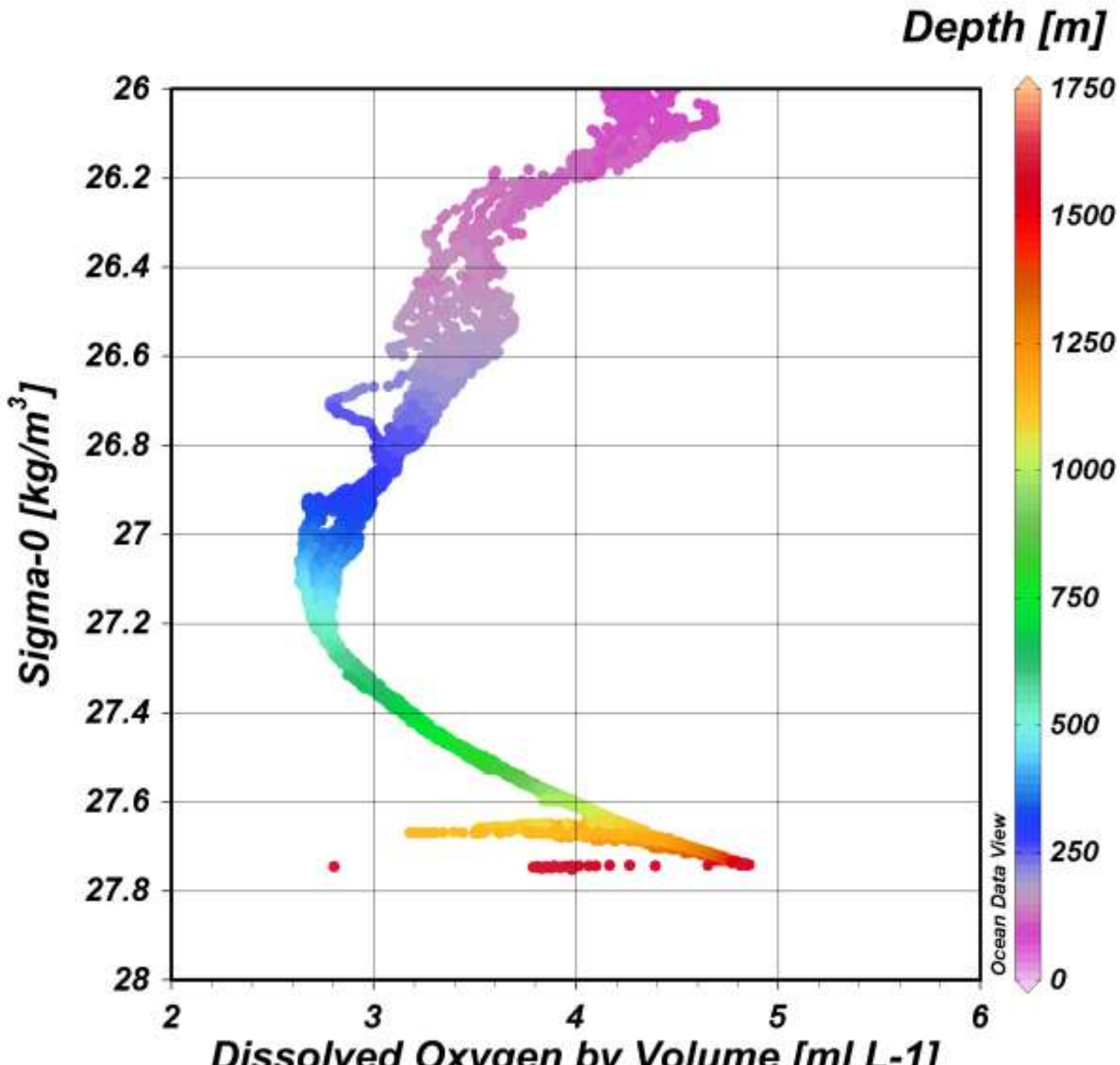
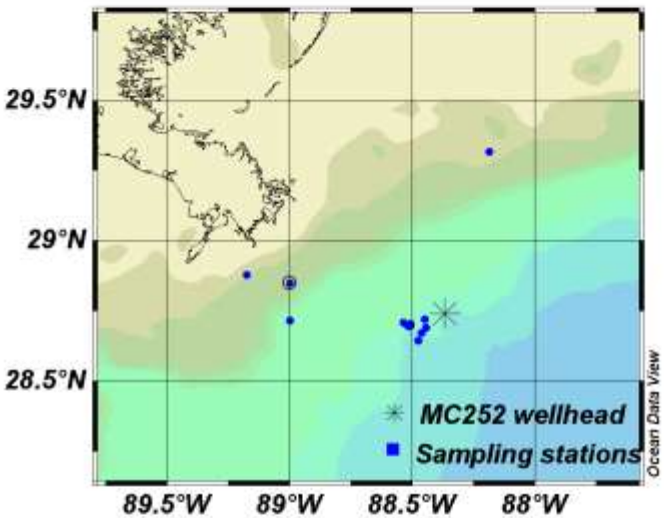
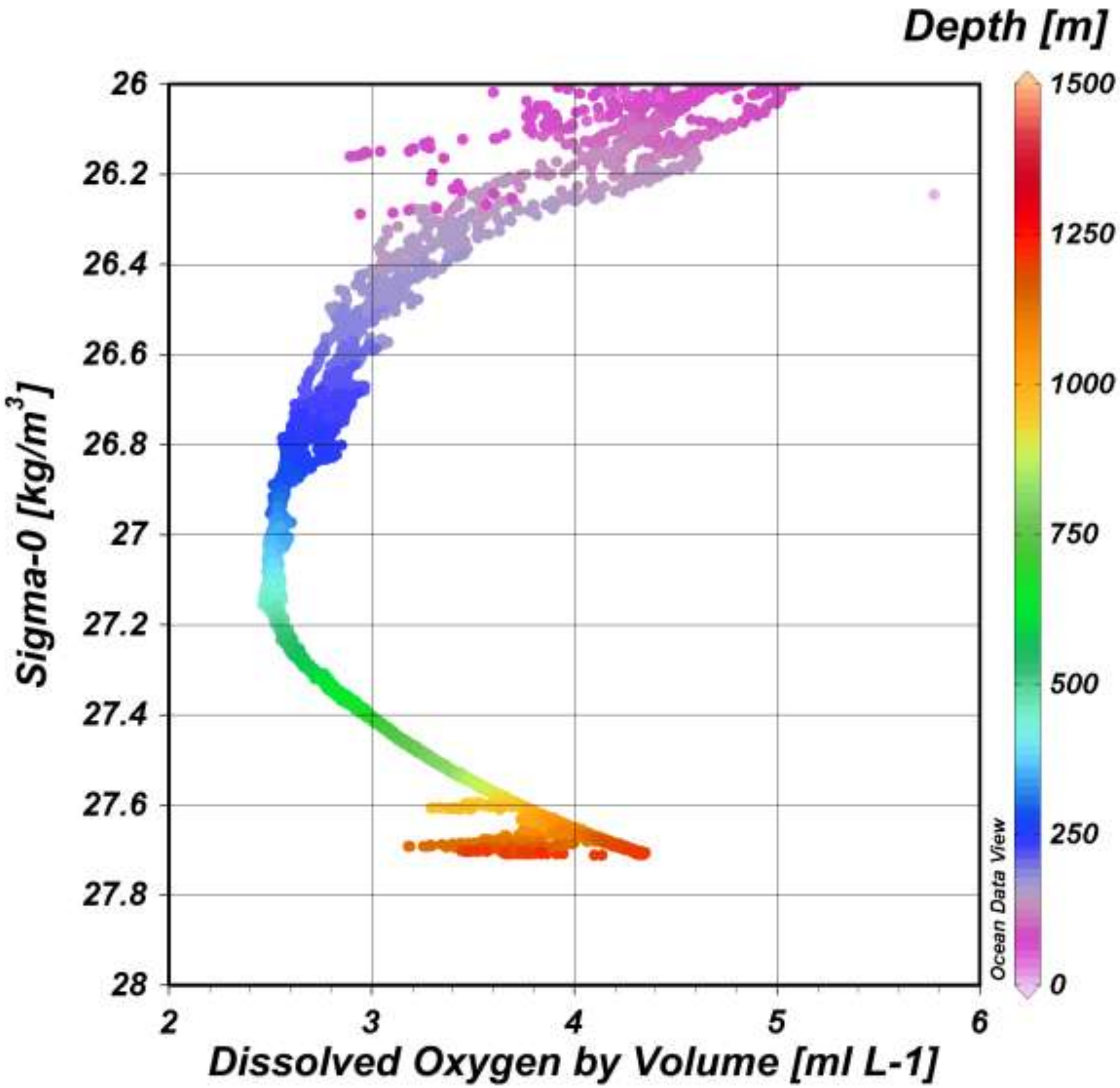


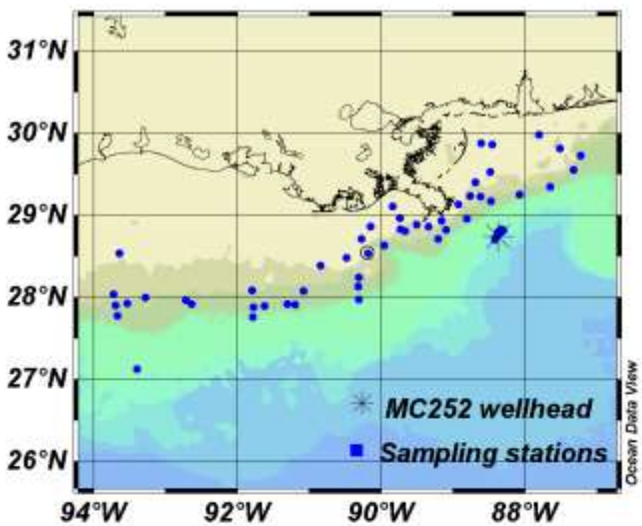
Figure 30. SBE 43 DO_2 measurements for R/V *Thomas Jefferson* cruise 2. Figure shows DO_2 concentrations as a function of Sigma theta and depth and the geographic location of stations.

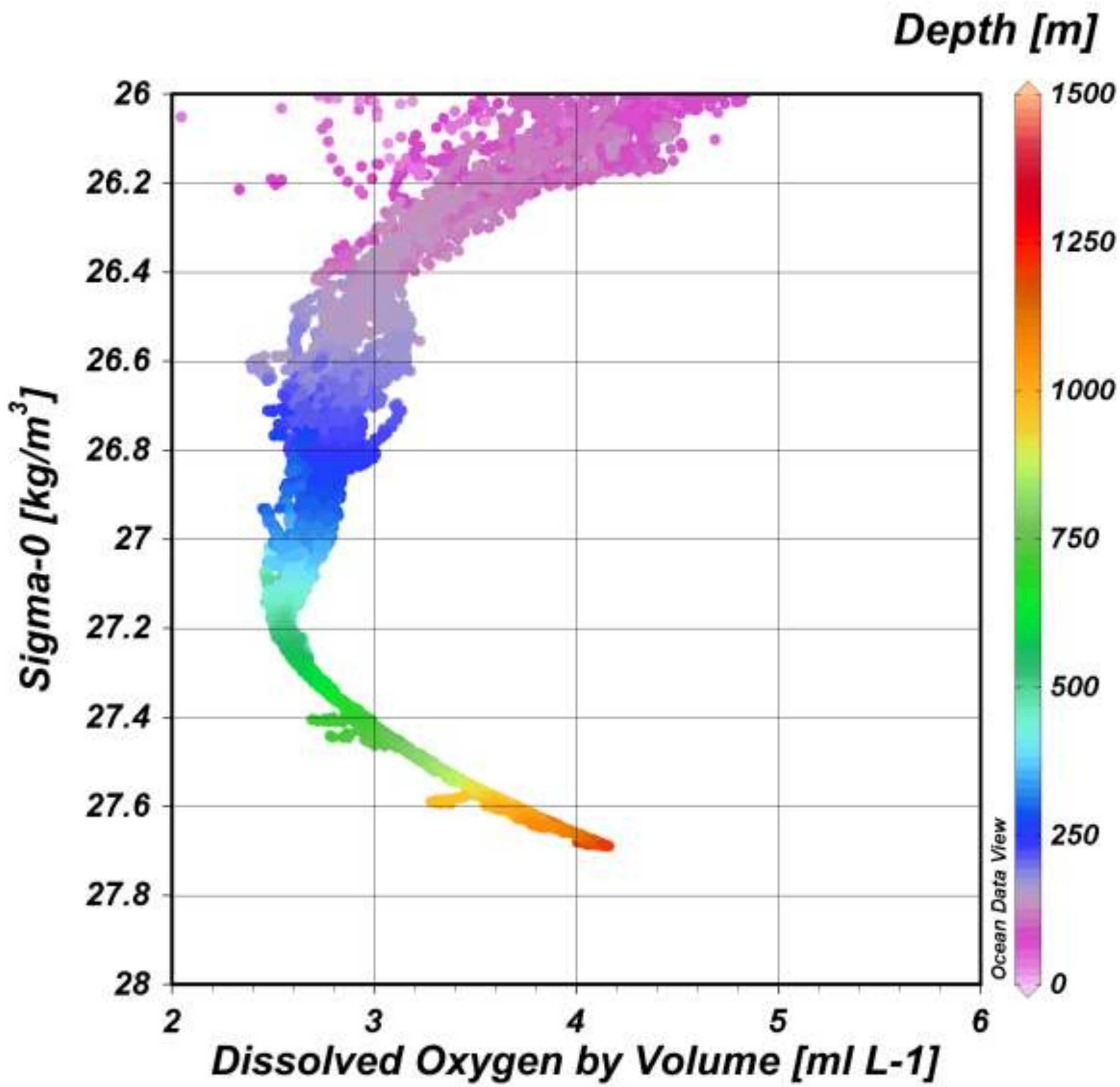




Preliminary Data Subject To Change

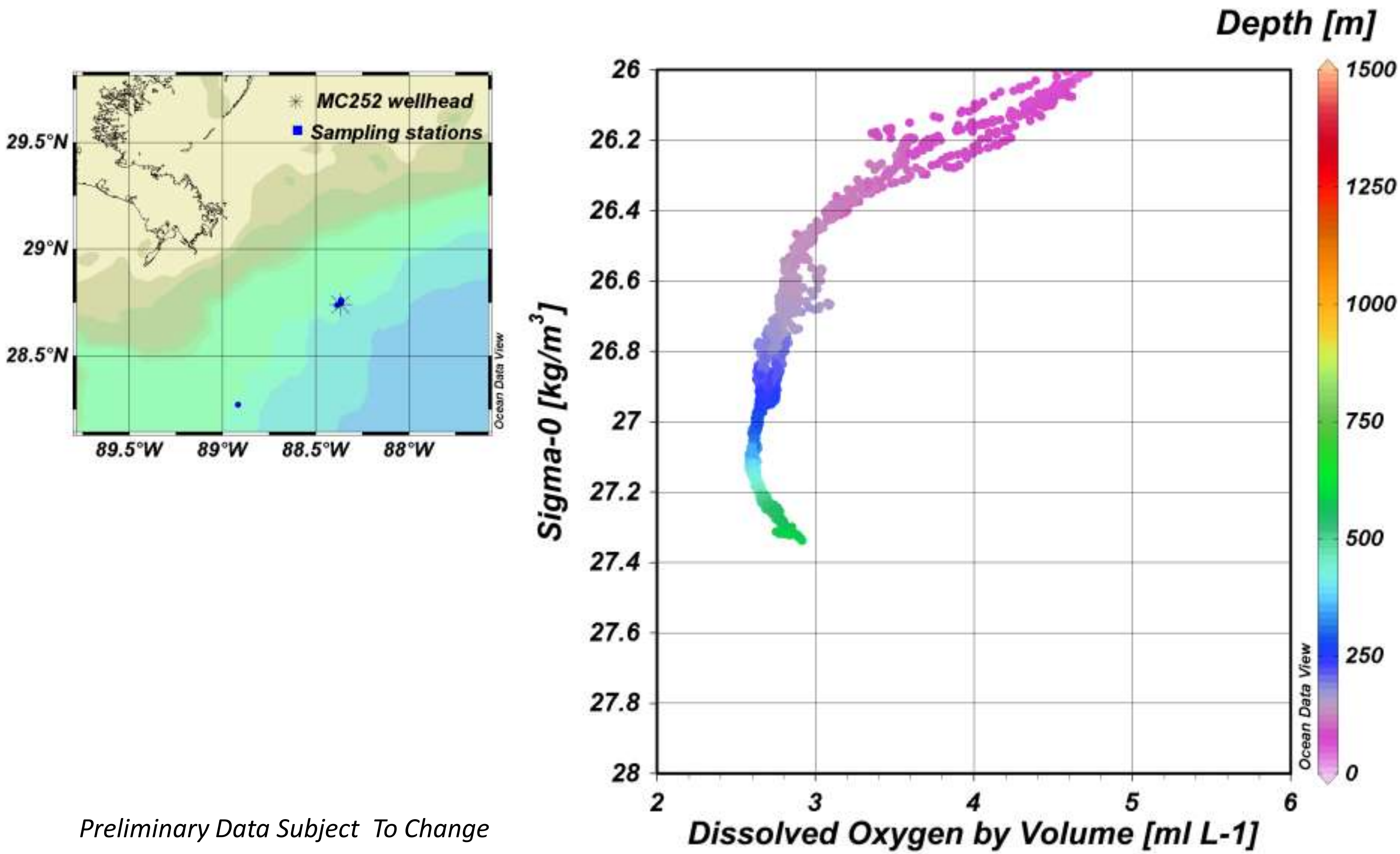
Figure 31. SBE 43 DO_2 measurements for R/V *Thomas Jefferson* cruise 3. Figure shows DO_2 concentrations as a function of Sigma theta and depth and the geographic location of stations.





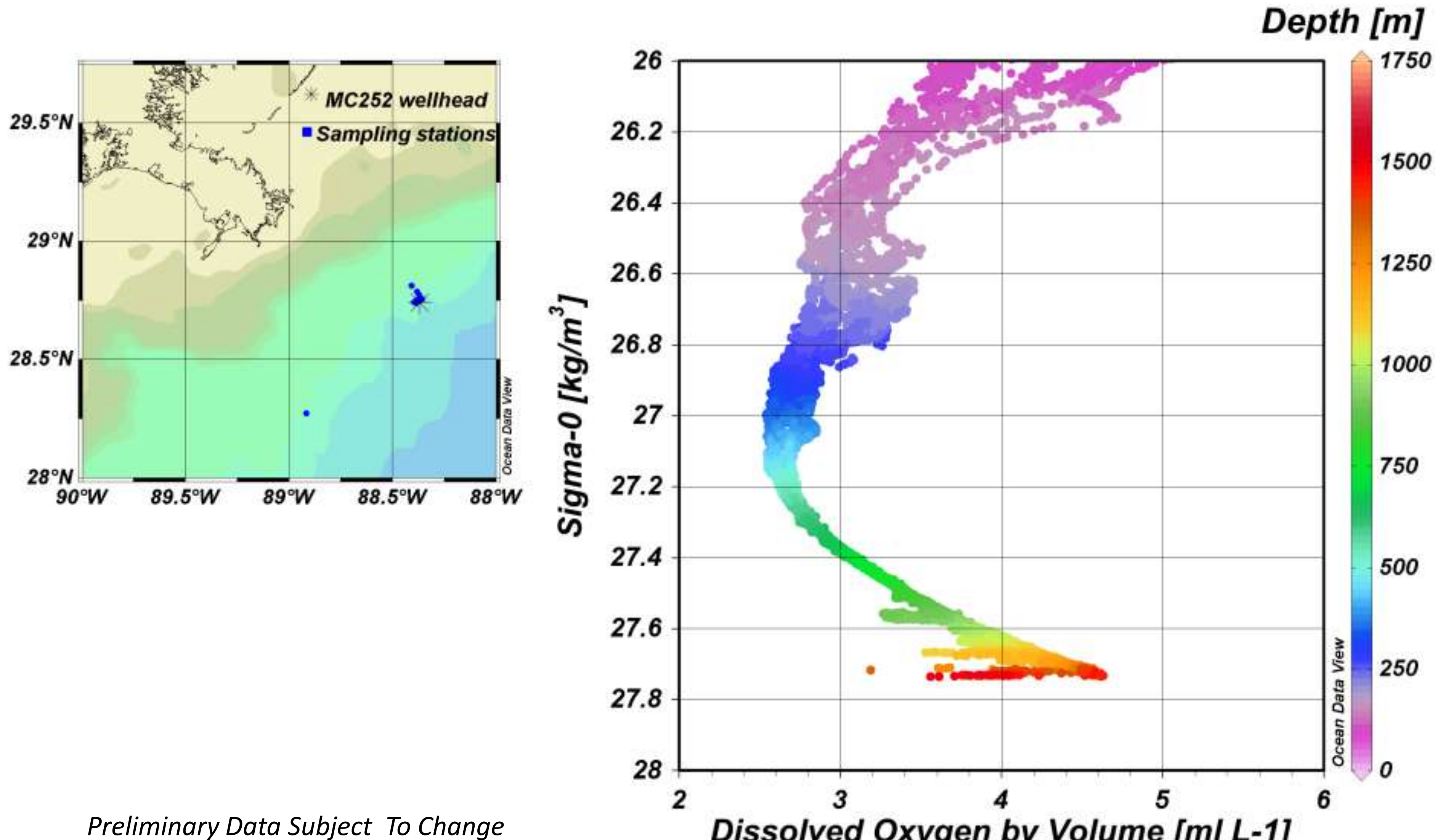
Preliminary Data Subject To Change

Figure 32. SBE 43 DO_2 measurements for R/V *Jack Fitz* cruise 1. Figure shows DO_2 concentrations as a function of Sigma theta and depth and the geographic location of stations.



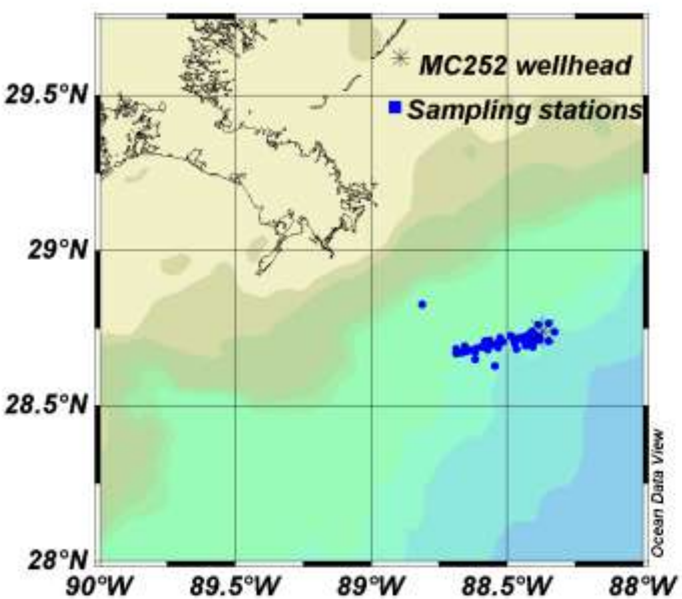
Preliminary Data Subject To Change

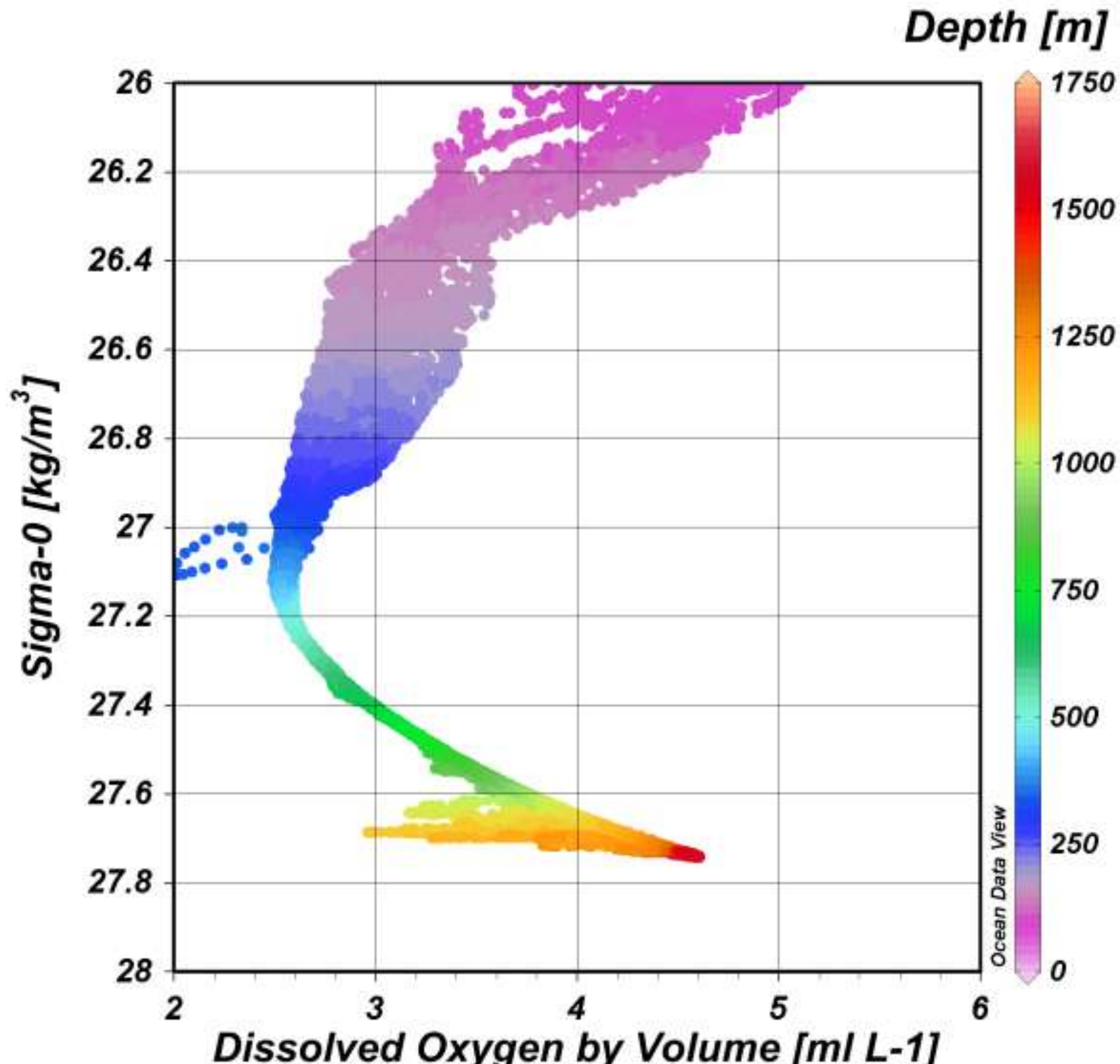
Figure 33. SBE 43 DO_2 measurements for R/V *Jack Fitz* cruise 3. Figure shows DO_2 concentrations as a function of Sigma theta and depth and the geographic location of stations.



Preliminary Data Subject To Change

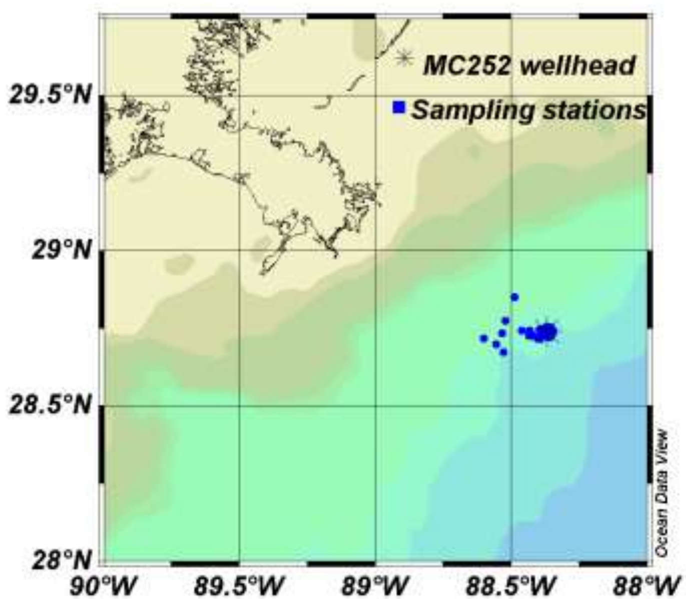
Figure 34. SBE 43 DO_2 measurements for R/V *Walton Smith* cruise 1. Figure shows DO_2 concentrations as a function of Sigma theta and depth and the geographic location of stations.

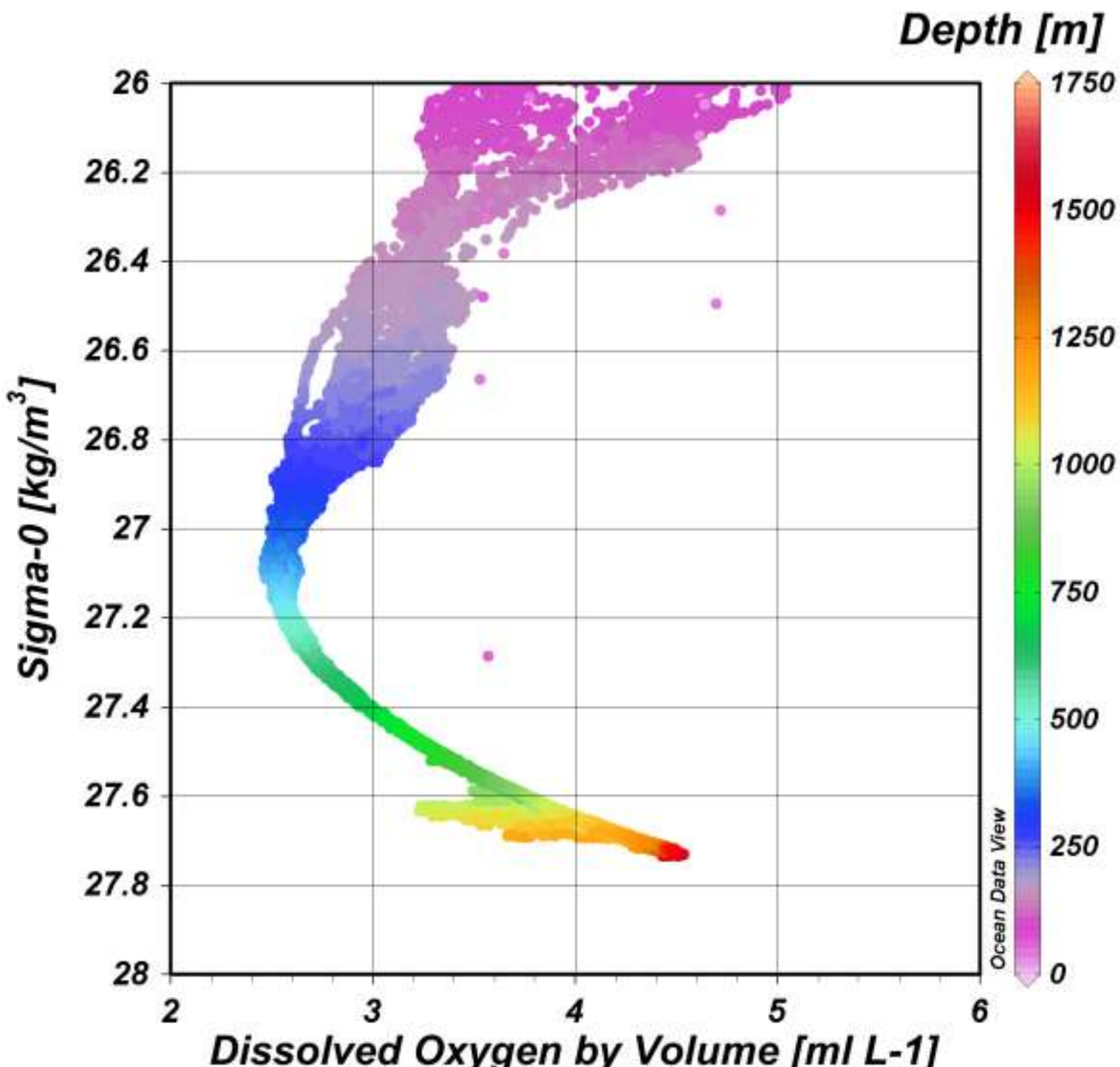




Preliminary Data Subject To Change

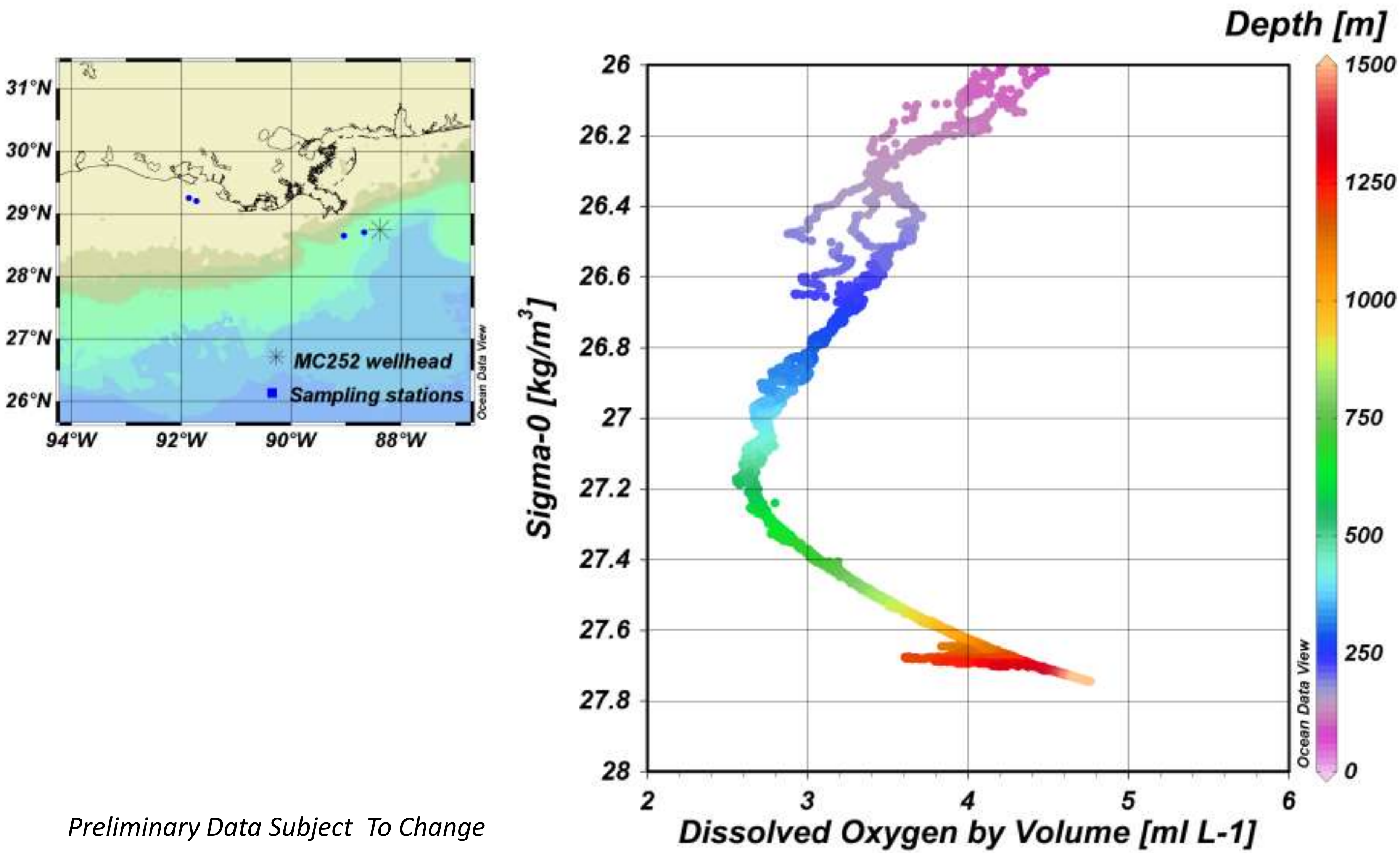
Figure 35. SBE 43 DO_2 measurements for R/V *Walton Smith* cruise 2. Figure shows DO_2 concentrations as a function of Sigma theta and depth and the geographic location of stations.





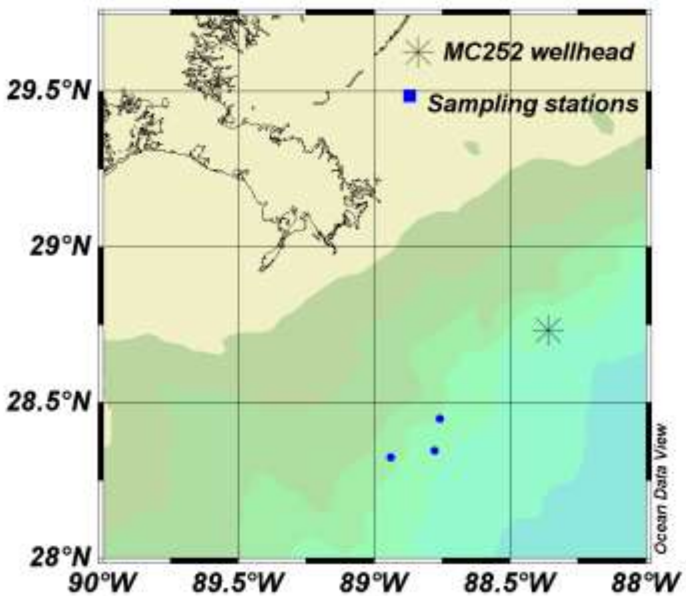
Preliminary Data Subject To Change

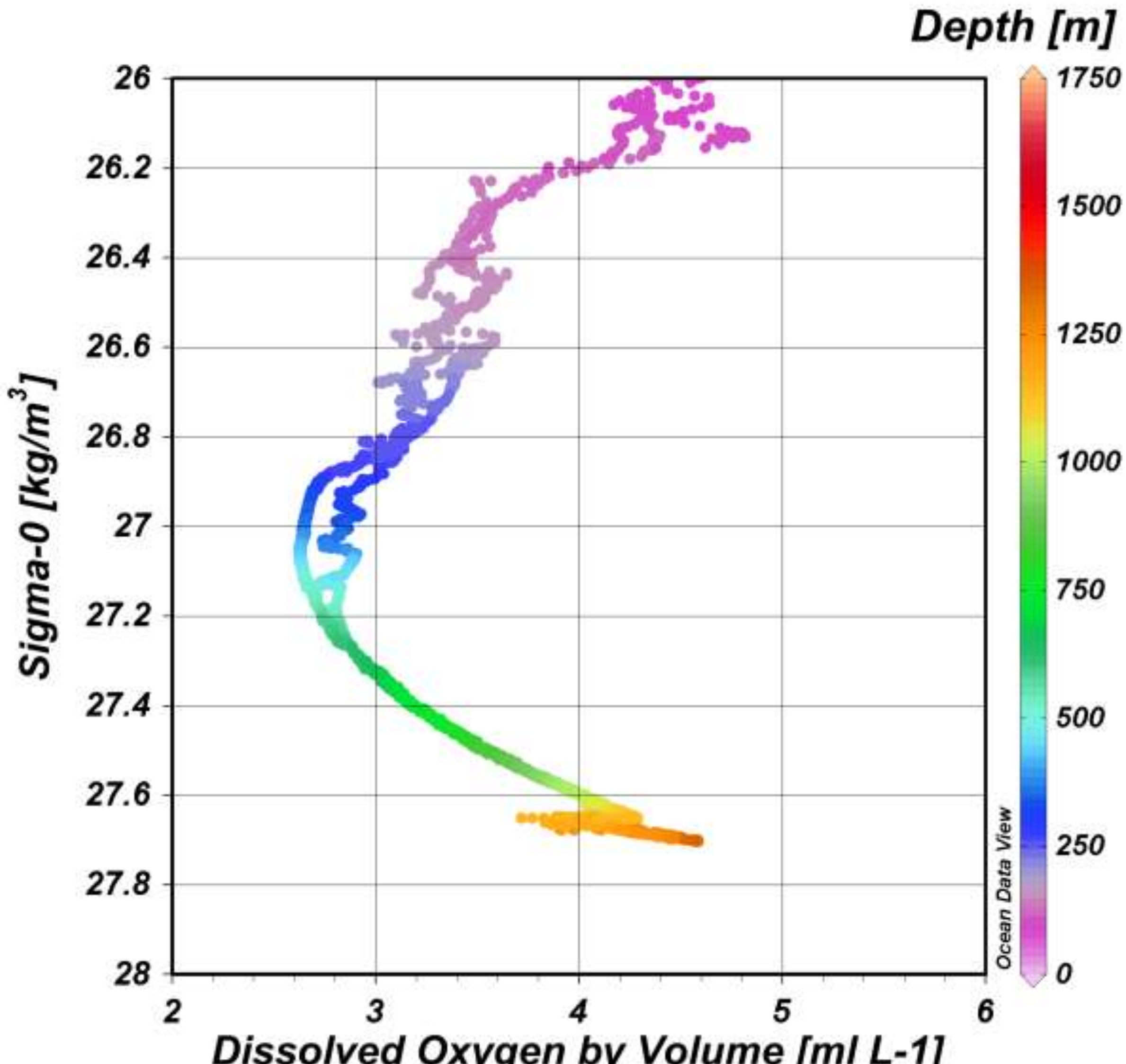
Figure 36. SBE 43 DO_2 measurements for R/V *Ferrel* cruise 2. Figure shows DO_2 concentrations as a function of Sigma theta and depth and the geographic location of stations.



Preliminary Data Subject To Change

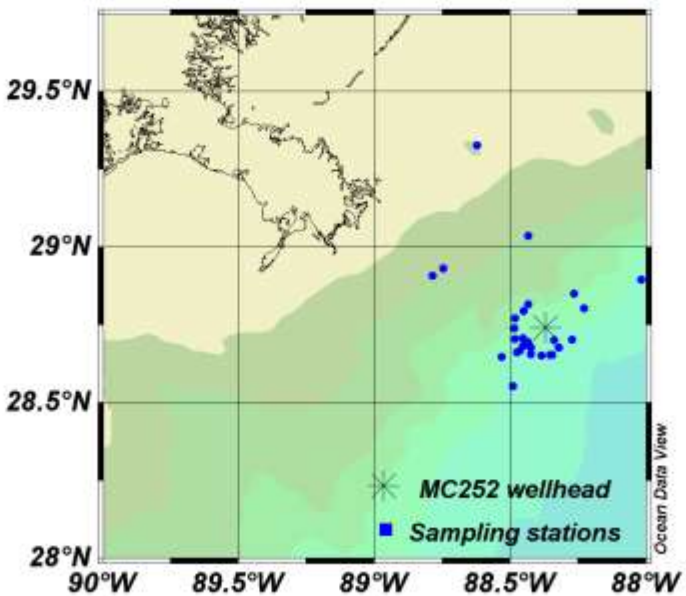
Figure 37. SBE 43 DO_2 measurements for R/V *Ferrel* cruise 4. Figure shows DO_2 concentrations as a function of Sigma theta and depth and the geographic location of stations.

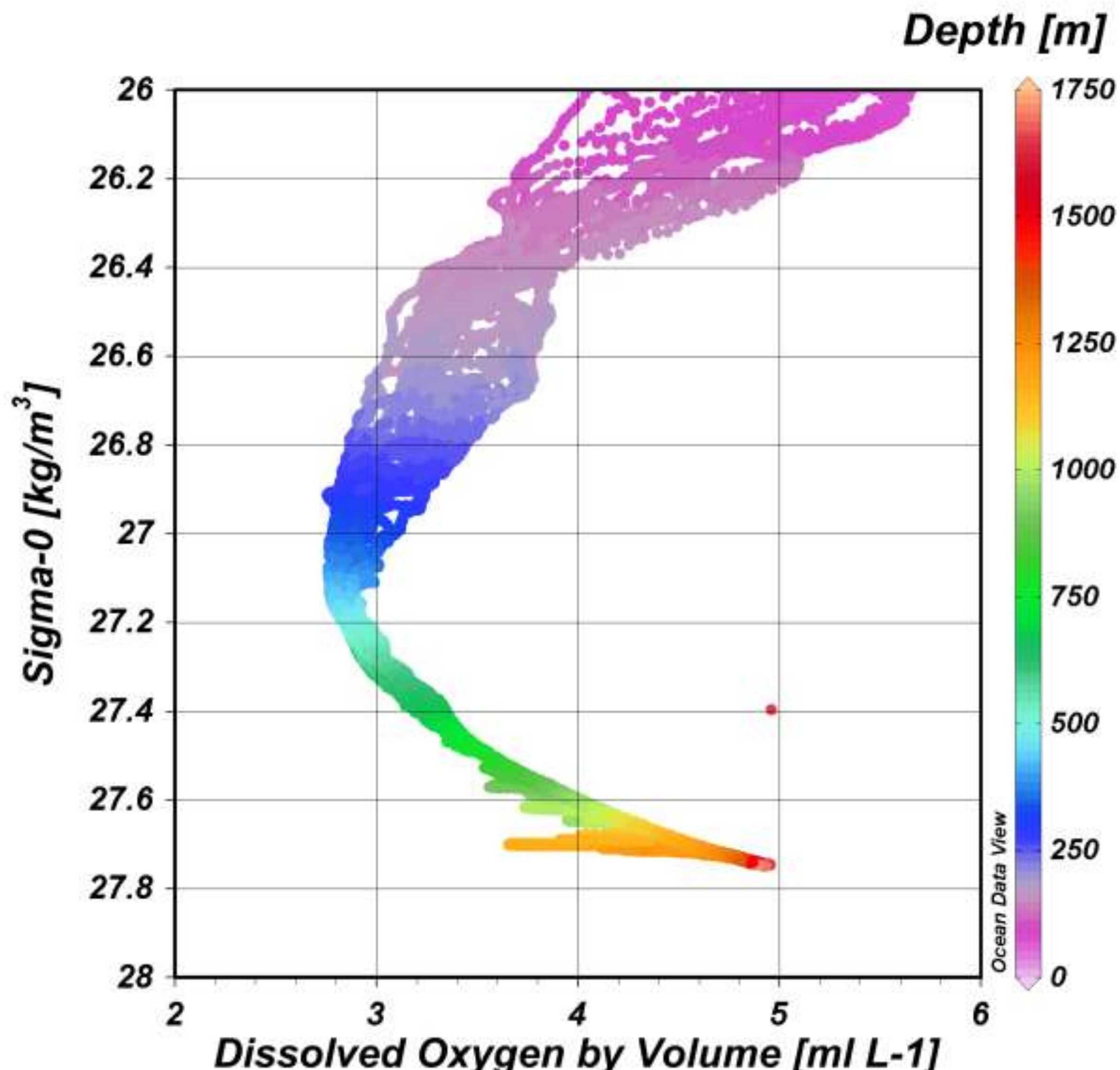




Preliminary Data Subject To Change

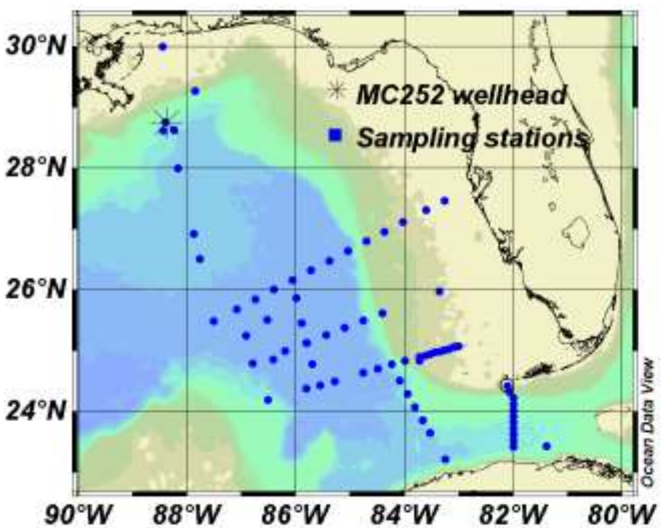
Figure 38. SBE 43 DO_2 measurements for R/V *Gordon Gunter* cruise 1. Figure shows DO_2 concentrations as a function of Sigma theta and depth and the geographic location of stations.

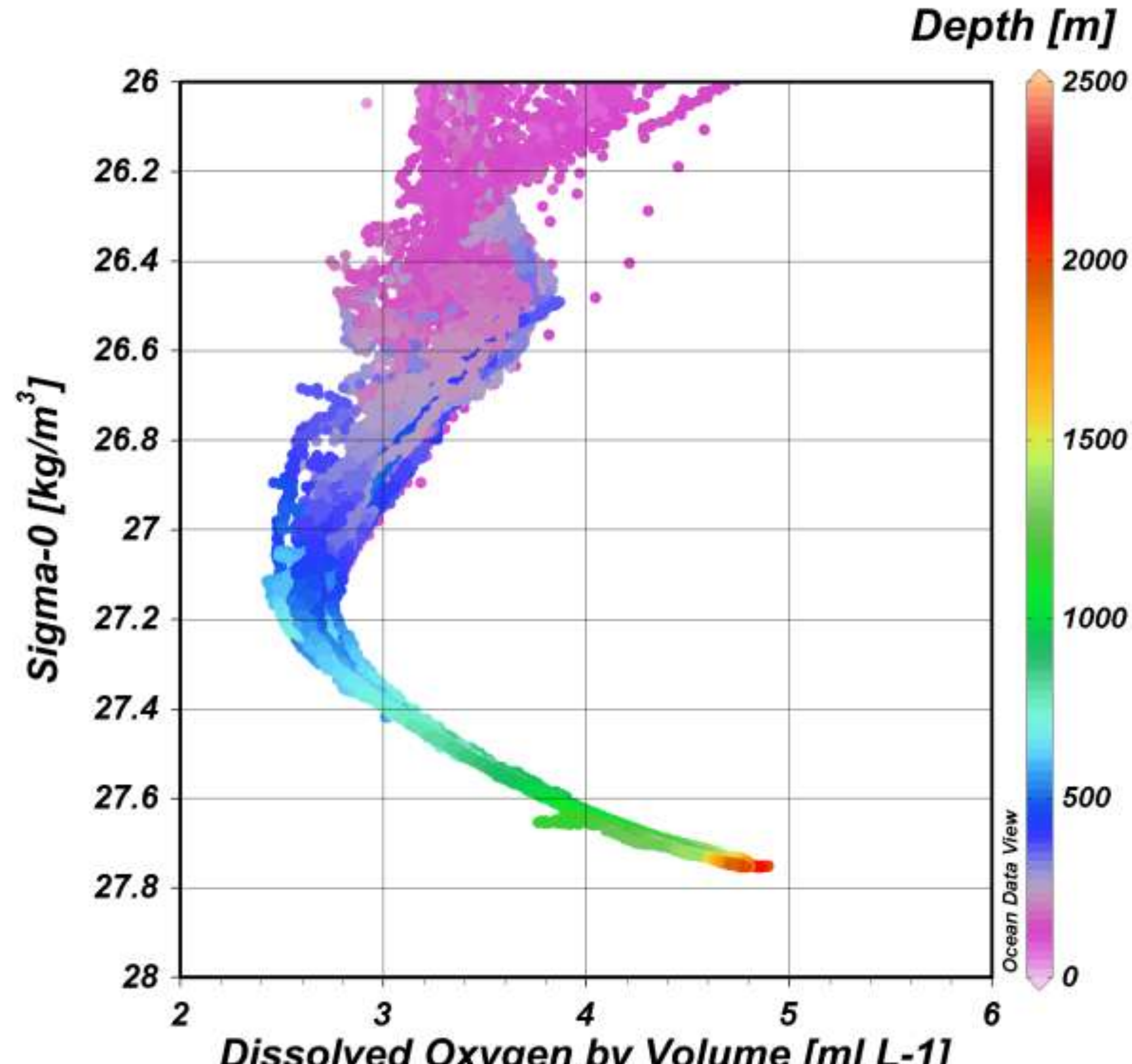




Preliminary Data Subject To Change

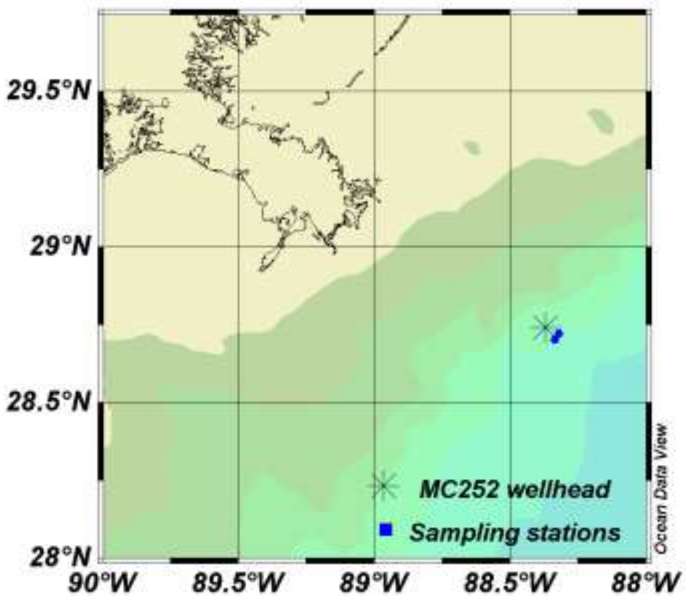
Figure 39. SBE 43 DO_2 measurements for R/V *Nancy Foster* cruise 1. Figure shows DO_2 concentrations as a function of Sigma theta and depth and the geographic location of stations.

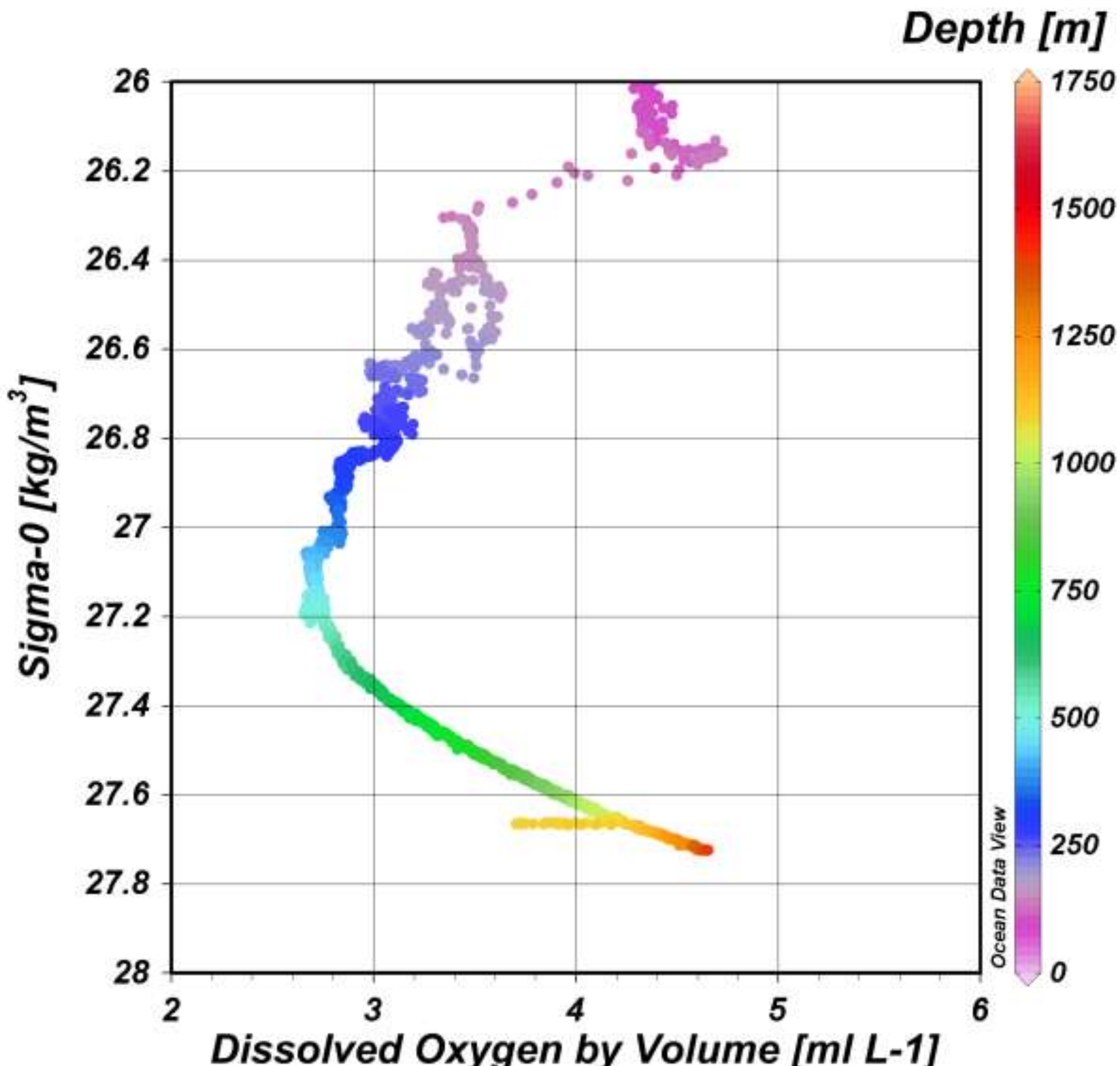




Preliminary Data Subject To Change

Figure 40. SBE 43 DO_2 measurements for R/V *Henry Bigelow* cruise 1. Figure shows DO_2 concentrations as a function of Sigma theta and depth and the geographic location of stations.





Preliminary Data Subject To Change

Figure 41. Mean SBE 43 DO_2 between 1000 and 1300 m as a function of date and distance from the wellhead. NODC 1° climatological annual mean and standard deviation shown as green lines.

Preliminary Data Subject To Change

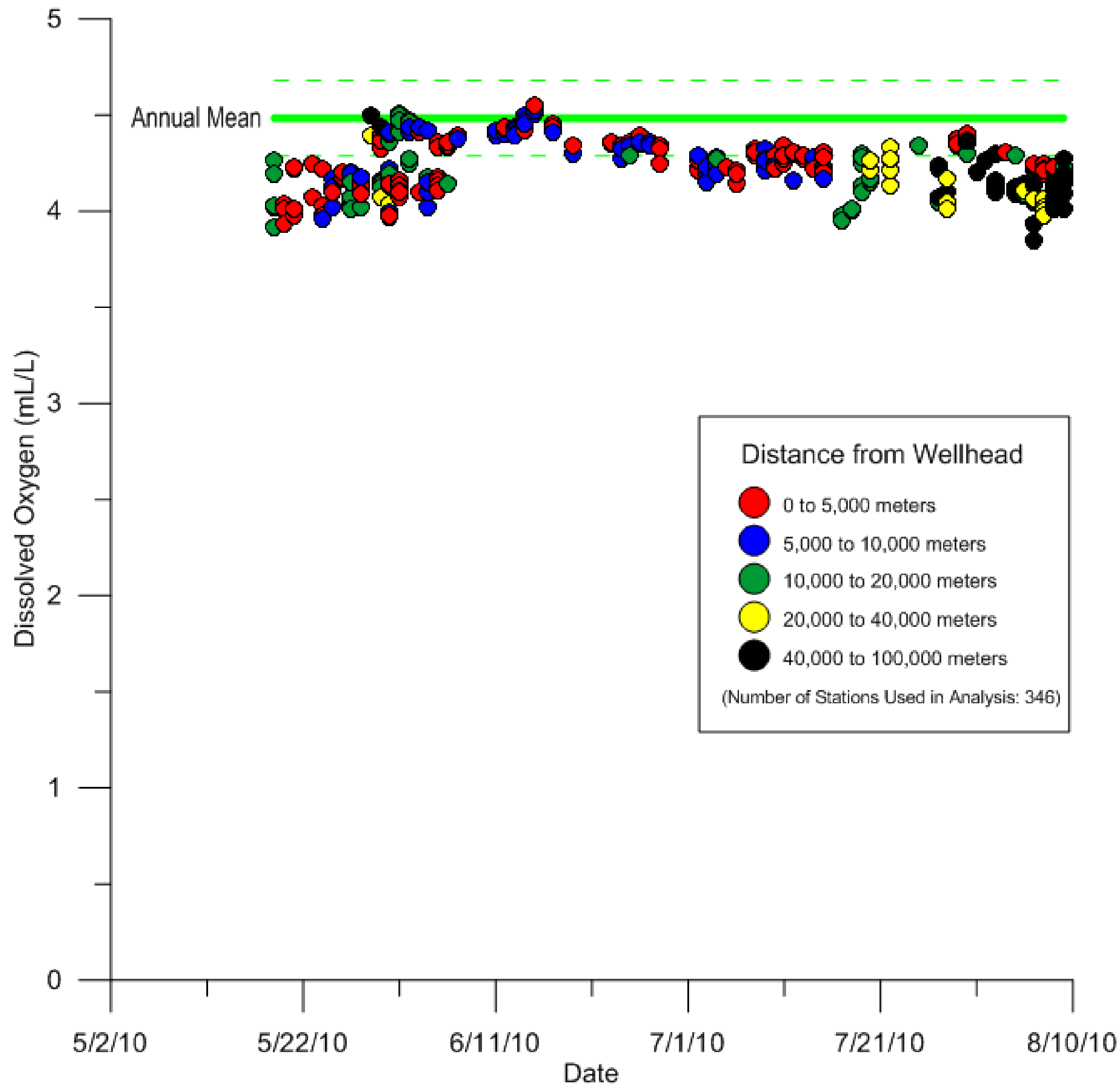


Figure 42. Mean SBE 43 DO_2 between 1000 and 1300 m as a function of distance from the wellhead and date. NODC 1° climatological annual mean and standard deviation shown as green lines

Preliminary Data Subject To Change

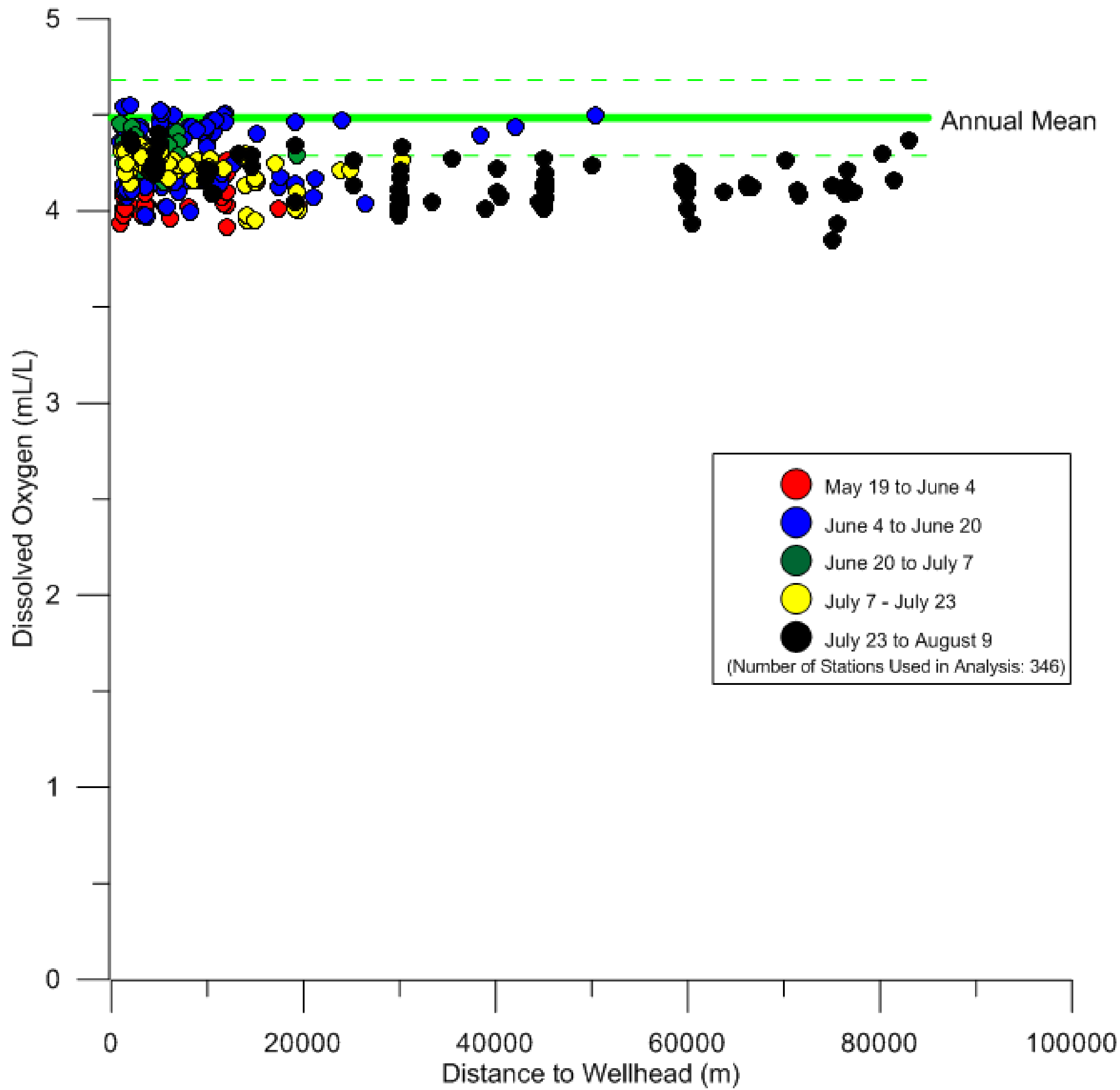


Figure 43. Minimum SBE 43 DO_2 between 1000 and 1300 m as a function of date and distance from the wellhead as compared to the level at which hypoxic conditions are considered to occur.

Preliminary Data Subject To Change

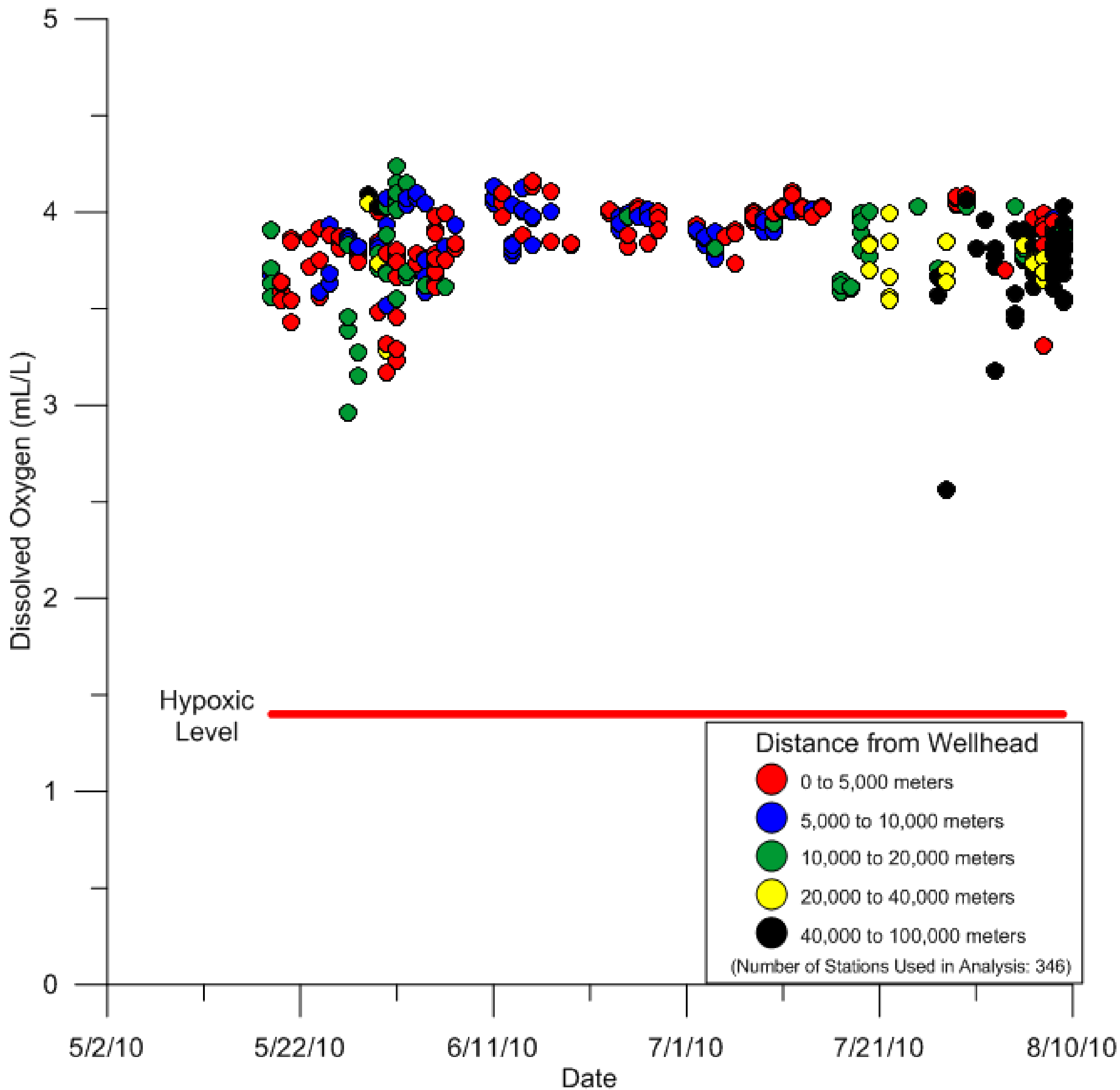
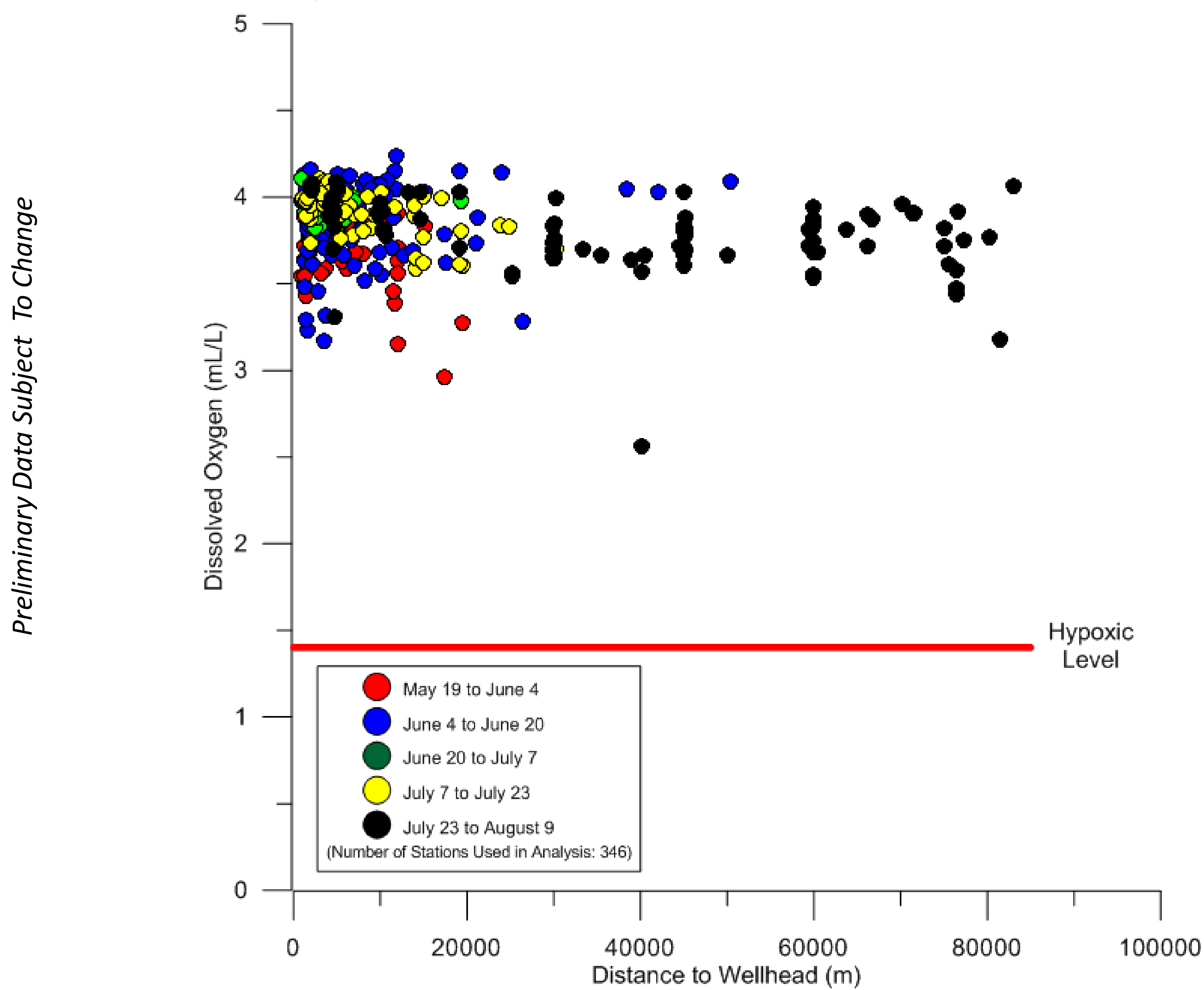


Figure 44. Minimum SBE 43 DO_2 between 1000 and 1300 m as a function of distance from the wellhead and date as compared to the level at which hypoxic conditions are considered to occur.



Map 3. Minimum SBE 43 dissolved oxygen values measured between 1000 and 1300 m depth in relation to location.

Preliminary Data Subject To Change