# Sentry Operations Report for the RR1712 Nooner/Chadwick Cruise DRAFT

**WHOI Sentry Operations Group**

Sean Kelley, Justin Fujii, Zac Berkowitz, Danik Forsman, Theo Guerin

Sentry Expedition Leader: Sean Kelley

Chief Scientist/PI: Scott Nooner, UNCW
Chief Scientist/PI: Bill Chadwick, OSU-HMSC

*R/V Roger Revelle* — July 13, 2017 to July 23, 2017

Publication Date: July 23, 2017

# 1 Summary

This document summarizes operations with the *Sentry* autonomous underwater vehicle (AUV) during the RR1712 Nooner/Chadwick cruise. Included in this report is the vehicle configuration; basic vehicle and sensor performance; and post-dive reports (with summary statistics and narratives). This report does not attempt to describe the scientific results or conclusions. A detailed description of the data files resulting from this cruise is provided in a separate document. Individual dive summaries for Sentry dives 442 through 446 follow — each of these is a free-standing document summarizing the dive.

# 2017 Chadwick/Nooner Cruise Sentry Navigation
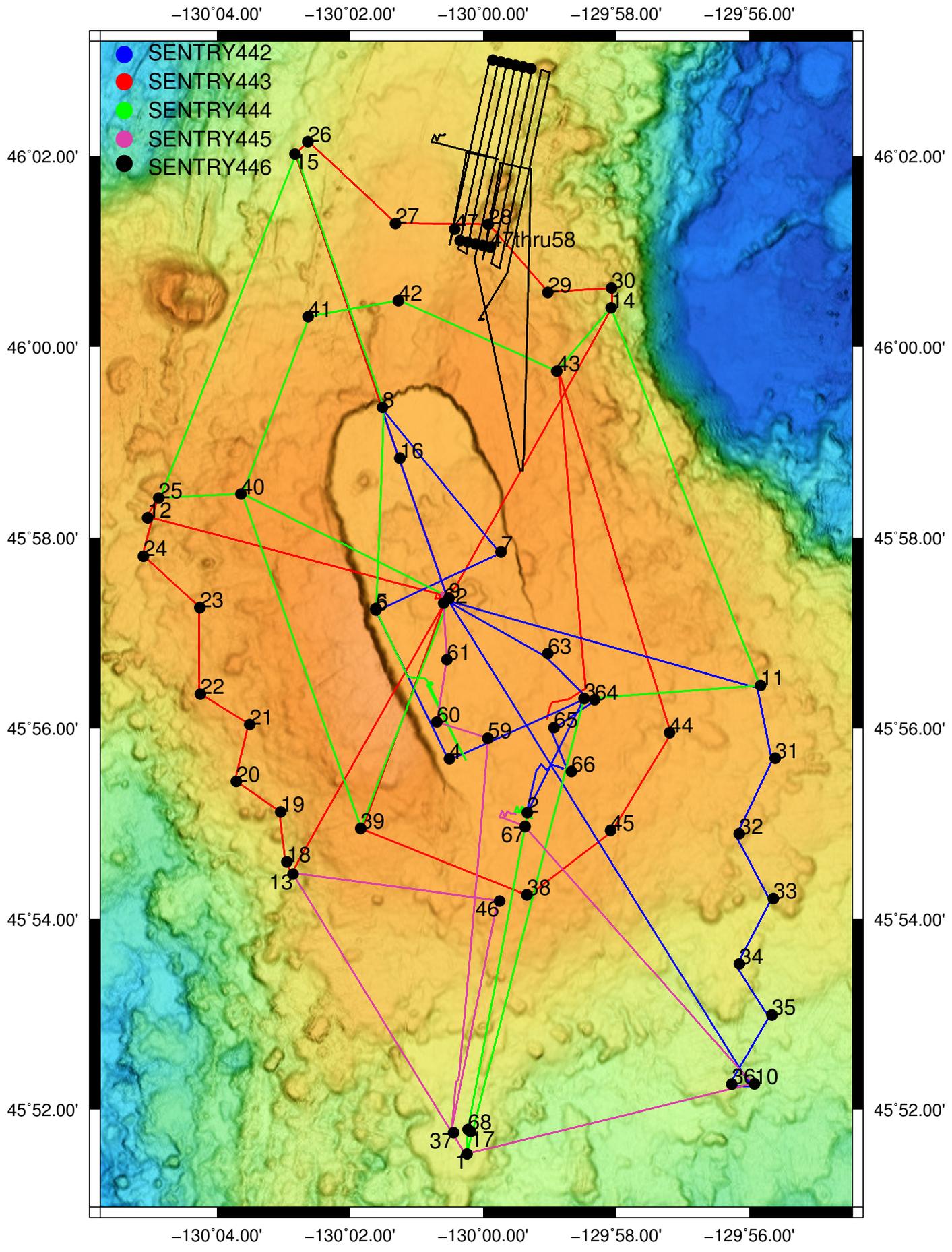
# 2 Cruise Log

This section provides a brief chronological summary of *Sentry* activities during the cruise. Additional information on specific dives is available in the dive reports.

**13 July 2017** Depart Newport, Oregon

**14 July 2017** On Station

**15 July 2017** Deployed Sentry442

**16 July 2017** Recover sentry442, Deployed sentry443

**17 July 2017** Recover sentry443

**18 July 2017** Deploy sentry444

**19 July 2017** Sentry444

**20 July 2017** Recover Sentry444, Deploy Sentry445

**21 July 2017** Recover Sentry445. Deploy sentry446

**22 July 2017** Recover Sentry446. Begin transit to Newport

**23 July 2017** Arrive Newport Oregon

# 3   Vehicle Configuration

Table 1 lists the science sensors installed on *Sentry* for this cruise.

Table 1: Sentry Sensor Configuration

| Sensor |
| --- |
| APS 1540 Magnetometers (3) |
| Reson 7125 Multibeam Sonar |
| Seabird SBE49 Conductivity-Temperature-Depth (CTD) |
| Seapoint optical backscatter sensor (OBS) |
| Anderaa optode model 4330 |
| 300kHz RDI Doppler Velocity Log (DVL) |
| Digital Still Camera |
| Blue View P900-90 Forward Looking Sonar |
| IXEA PHINS |
| Reson Sound Velocity Probe |
| NOAA PMEL MAPR |
| NOAA PMEL ORP Sensor |

# 4   Navigation

All dives were navigated using real time DVL velocity inertial measurement unit (IMU) attitude measurements. External aiding during descent was performed with Ultra-Short Baseline (USBL) throughout the cruise. Dive specific notes on navigation are included in the dive reports. All final navigation consists of a track where the DVL/IMU track was fused with the USBL fixes in post-processing.

## 4.1   Coordinate origins

The vehicle's control system uses simple equidistant coordinates. This system uses an origin, defined in terms of latitude and longitude with the World Geodetic System 1984 (WGS84) datum, and a fixed scaling between meters displacement from the origin. We use the identical routines that have been used by the National Deep Submergence Facility (NDSF) assets Alvin and Jason for decades. Likewise we always used the same origin for Sentry and Alvin at each site. These simple coordinates have several advantages for realtime control of a vehicle. Unlike Universal Transverse Mercator (UTM) grid coordinates, the x and y axes intersect at right angles and align with true east and north respectively at the origin. These coordinates distort quickly as one moves away from the origin, but we solve that problem by putting the origin close to the operating area. Most of our results are reported in latitude/longitude, so most users need not be aware of these details.

## 4.2   USBL Calibration and Performance Notes

A CASIUS calibration of the USBL system was conducted by the jason and sentry group at the beginning of the cruise. A copy of the USBL calibration report is included in this report.

# 5    Items of Note

This section summarized details which are worthy of note or mention for future reference but which do not constitute problems:

**N.1:** Jason operations were simultanous with sentry operations

**N.2:** Sidescan and sub bottom was not required and powered off to maximize dive time

**N.3:** NOAA PMEL MAPR sensor was run in autonomous mode and attached to the stern of Sentry

**N.4:** Jason Operations in water transit speed was limited to 0.5 knots in single body mode adding difficulty in operations.

**N.5:** Several Sentry recoveries were delayed to allow jason operations to recover first before Sentry was recovered.

**N.6:** Sentry LBL navigation was working out to 7km horizonatally away from the ship

**N.7:** USBL navigation was limited to 1500 meters horizontal distance from the ship

# 6    Ship Specific Information

This section summarizes ship specific information and is meant primarily to facilitate more effective use of the same vessel in the future.

**S.1:** Sentry server van location was main deck stbd side

**S.2:** Sentry van was 03 deck forward

# 7    Technical Issues

This section summarizes technical issues encountered by the *Sentry* operations group on the cruise. Issues which affected primarily individual dives are listed in the individual dive reports.

**T.1:** Systematic issues throughout the cruise were not present. Individual issues are noted within the dive reports.

# 8    Sentry Operations Team

The *Sentry* team was comprised of 5 members on this cruise — Sean Kelley, Justin Fujii, Zac Berkowitz, Danik Forsman, Theo Guerin. Sean Kelley was the Expedition Leader and the principal author of this report.

# 9    Acknowledgments

# Sentry 442 Dive Report
# DRAFT

**WHOI Sentry Operations Group**

Sean Kelley, Justin Fujii, Zac Berkowitz, Danik Forsman, Theo Guerin

Sentry Expedition Leader: Sean Kelley

Chief Scientist/PI: Scott Nooner, UNCW
Chief Scientist/PI: Bill Chadwick, OSU-HMSC

# Summary

**Weather:** winds were 15knots and 2 to 4 foot seas for launch, 10knot winds and 2 foot seas for recovery

**Reason for end of dive:** The dive was ended due to time.

# Vehicle Configuration

The science sensing suite for this dive was:

Table 2: Sentry Sensor Configuration

| Sensor |
| --- |
| APS 1540 Magnetometers (3) |
| Reson 7125 Multibeam Sonar |
| Seabird SBE49 CTD |
| Seapoint OBS |
| Anderaa optode model 4330 |
| 300kHz RDI DVL |
| Digital Still Camera |
| Blue View P900-90 Forward Looking Sonar |
| IXEA PHINS |
| Reson Sound Velocity Probe |
| NOAA PMEL MAPR |
| NOAA PMEL ORP Sensor |

# Important Positions

**Dive Origin:** 45 45.0000 -130 -12.0000

**Launch Position:** sentry442 launch position: 45 55.572'N 129 58.800'W

# Narrative

Sentry442 was the first dive of the cruise at axial caldera. The Sentry launch went very well for the first dive of the cruise, testing the fly away system used to drive sentry away from the ship. Sentry completed 52km of multibeam mapping on the inside of the caldera as well as an additional section to the south east. Recovery went well with favorable conditions and easy motion through the water for both Sentry and the ship.

# Issues

None

# Chief Scientist Comments

None

# Dive Statistics

## 0.1 sentry442 Summary

sentry442 Summary
Origin: 45.750000 -130.200000
Origin: 45 45.000'N 130 12.000'W
Launch: 2017/07/15 18:03:22
Survey start: 2017/07/15 18:38:38
Survey start: Lat:45.926268 Lon:-129.980157
Survey start: Lat:45 55.576'N Lon:129 58.809'W
Survey end: 2017/07/16 09:44:33
Survey end: Lat:45.925775 Lon:-129.978573
Survey end: Lat:45 55.547'N Lon:129 58.714'W
Ascent begins: 2017/07/16 09:44:33
On the surface: 2017/07/16 10:13:44
On deck: 2017/07/16 10:32:14
descent rate: 41.1 m/min
ascent rate: 51.4 m/min
survey time: 15.1 hours
deck-to-deck time 16.5 hours
Mean survey depth: 1507m
Mean survey height: 65m
distance travelled: 52.84km
average speed; 0.97m/s
average speed during photo runs: NaN m/s over 0.00 km
average speed during multibeam runs: 0.98 m/s over 52.84 km
total vertical during survey: 3014m
Battery energy at launch: 20.4 kwhr
Battery energy at survey end: 7.4 kwhr
Battery energy on deck: 7.2 kwhr

# Sensor Information

This is a recently added section with selected sensor metadata. This section will be expanded in coming months. Additional data is available in the sentryxxx/nav-sci/proc directory within the sentryxxx_config matlab structure as well as in ascii text logs in sentryxxx/metadata. At present metadata is not yet automatically collected on all sensors.

## 0.2 sentry442 Devices

| Instrument | Model | Serial Num. | Comments | Config File |
|---|---|---|---|---|
| USBL | Sonardyne AvTrak2 | | | `avtrak_20170715_1503.cfg` |
| DVL | RDI Navigator (300kHz) | 727-2000-00M | CX: 1, WP: 0 | `dvl300_20170715_1504.cfg` |
| CTD | SBE 49 | 222 | | `sbe49_20170715_1504.cfg` |
| SAIL | obs A/D<br>orp A/D | 13<br>9 | A: 5, G: 1.00, O: 0<br>A: 3, G: 1.00, O: 0.002 | `a2d2-pods_20170715_1504.cfg` |

# Plots and Images

This section contains selected images of data products and plots of vehicle navigation and selected sensors.

Sentry442 dive tracks (Red) and planned survey (Black Line)
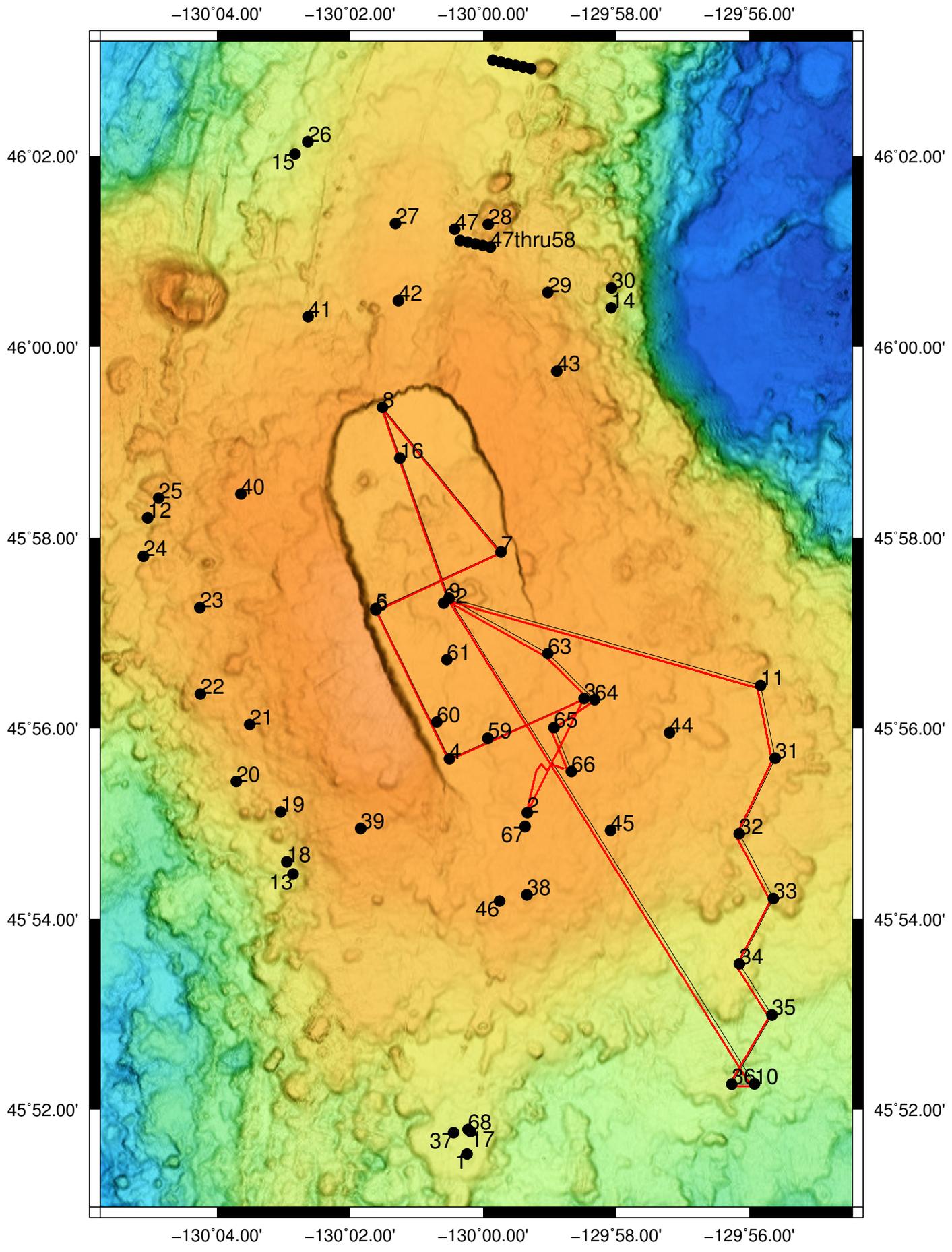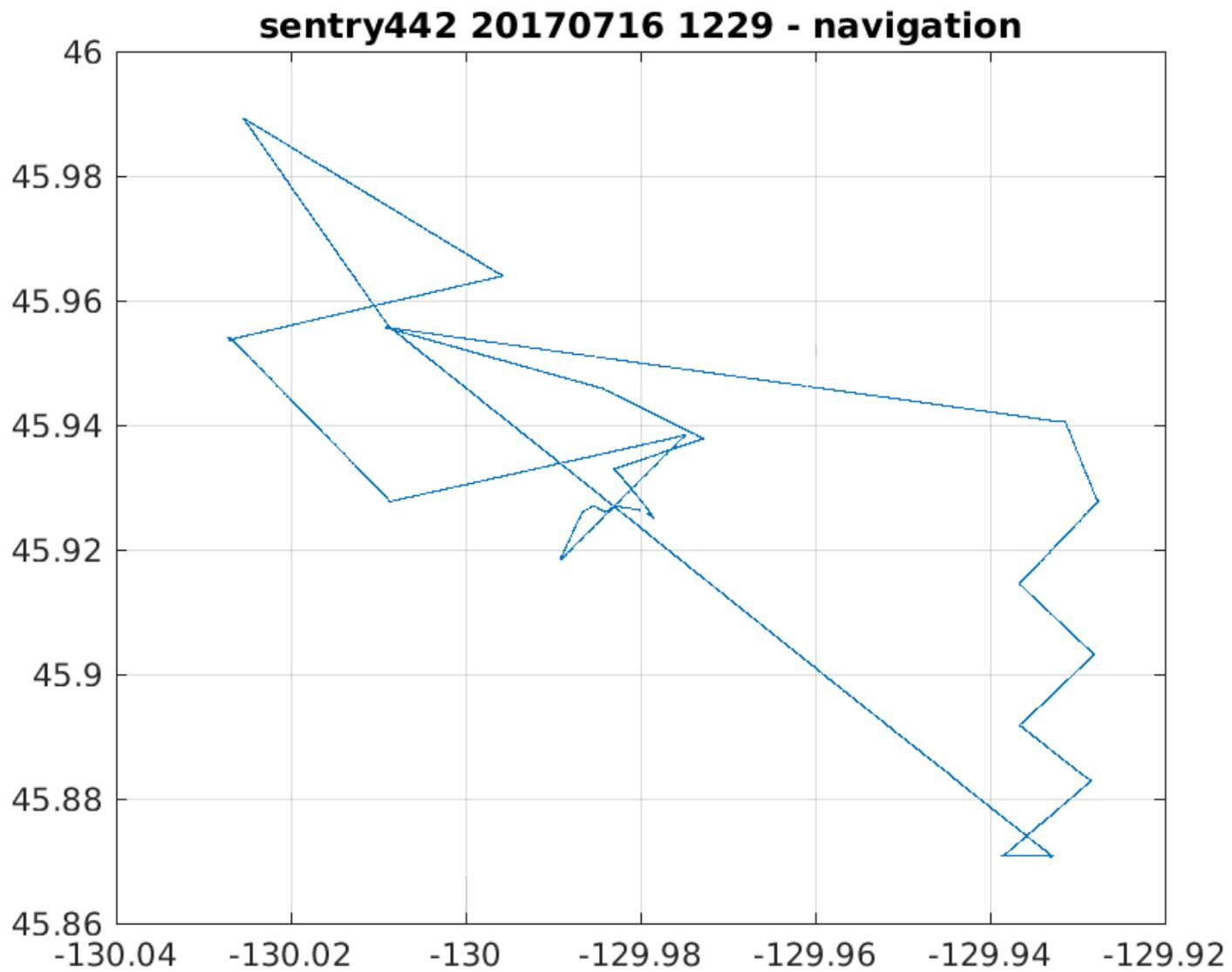
Figure 1: Latitude/Longitude plot of Sentry dive 442 based on post-processed navigation.
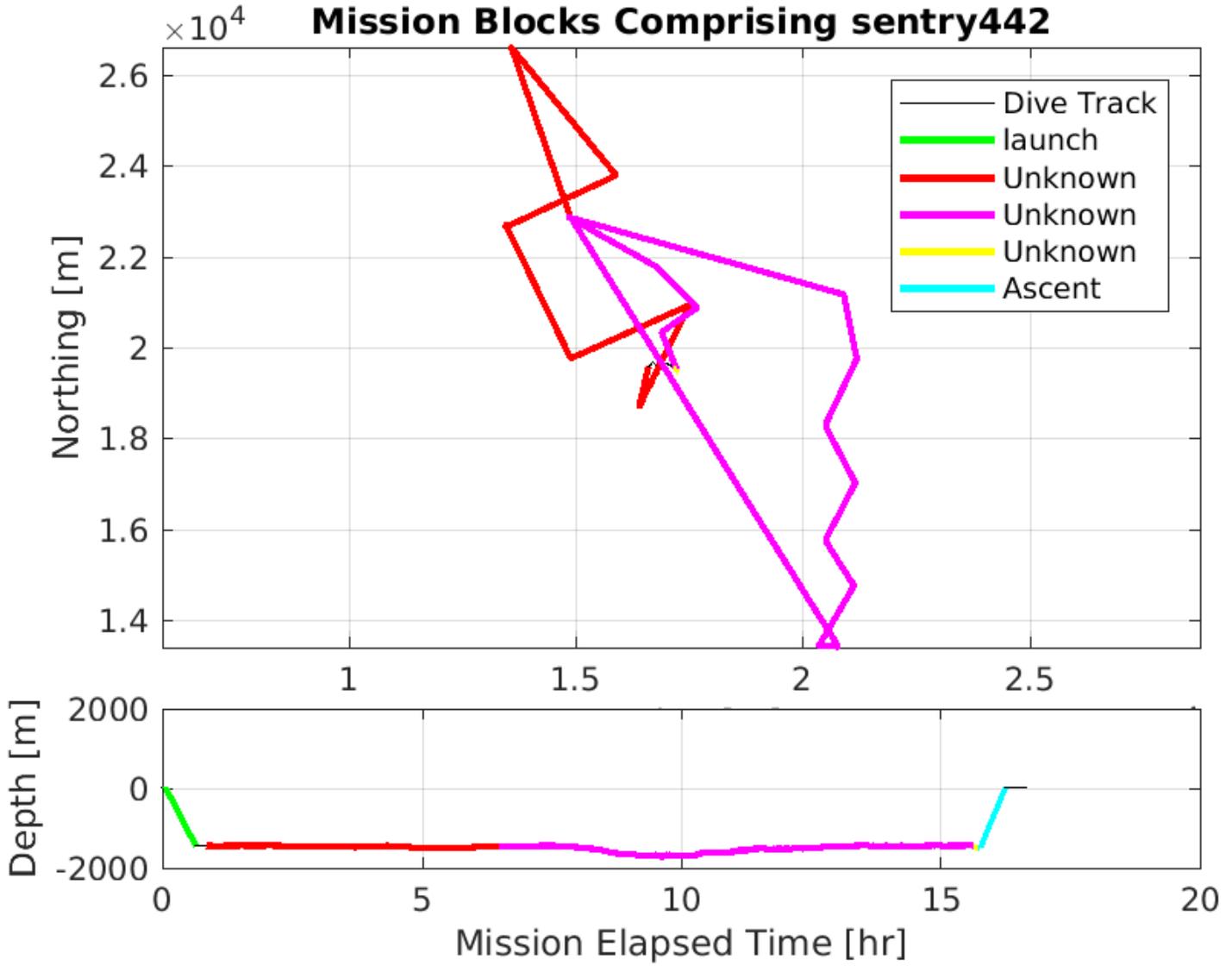
Figure 2: Mission Survey Blocks of Sentry dive 442
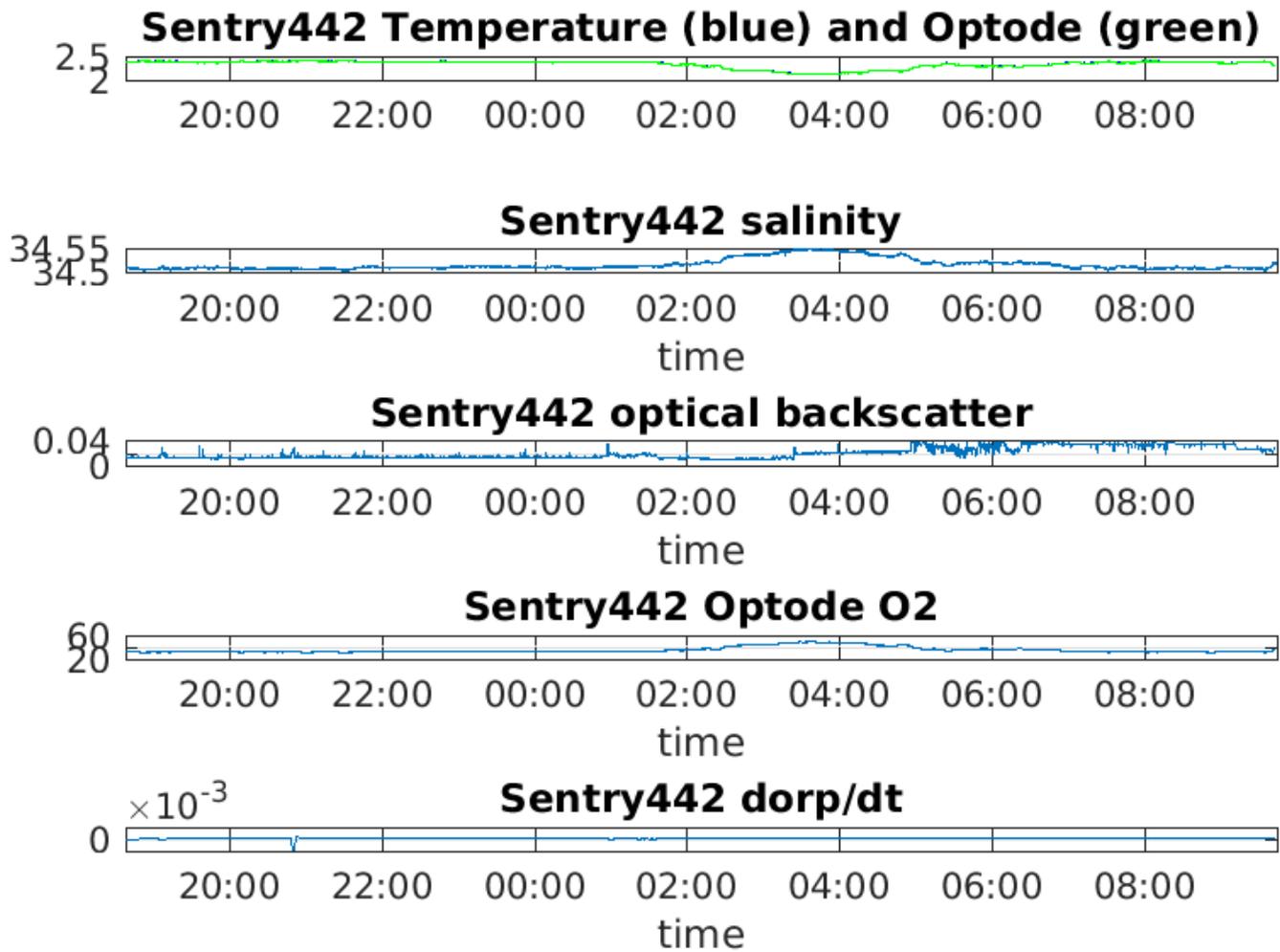
Figure 3: Time series plot of five of the basic sensors on Sentry, from top to bottom, temperature, salinity, optical backscatter, dissolved Oxygen, and ORP.
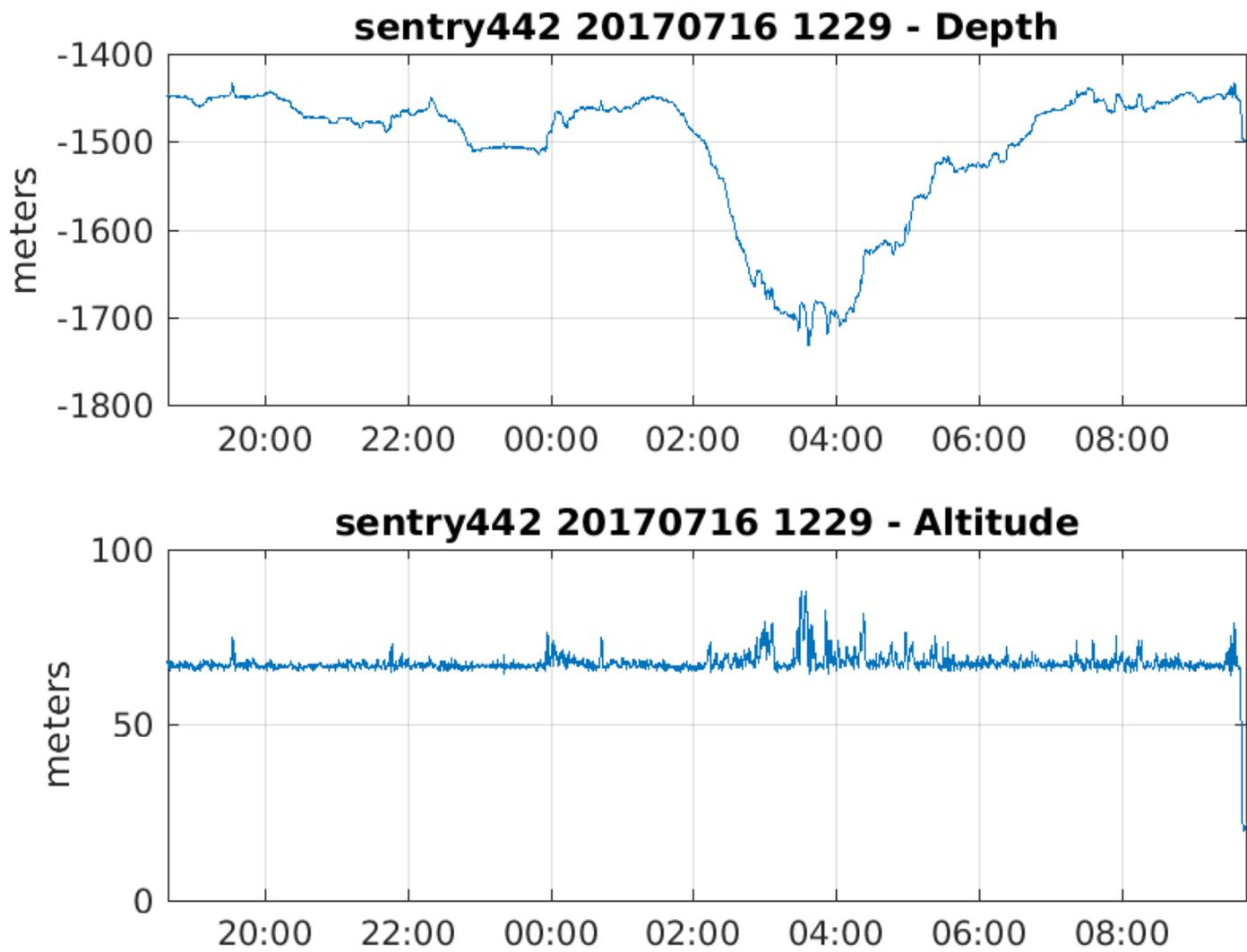
Figure 4: Depth and Altitude of Sentry during dive 442.
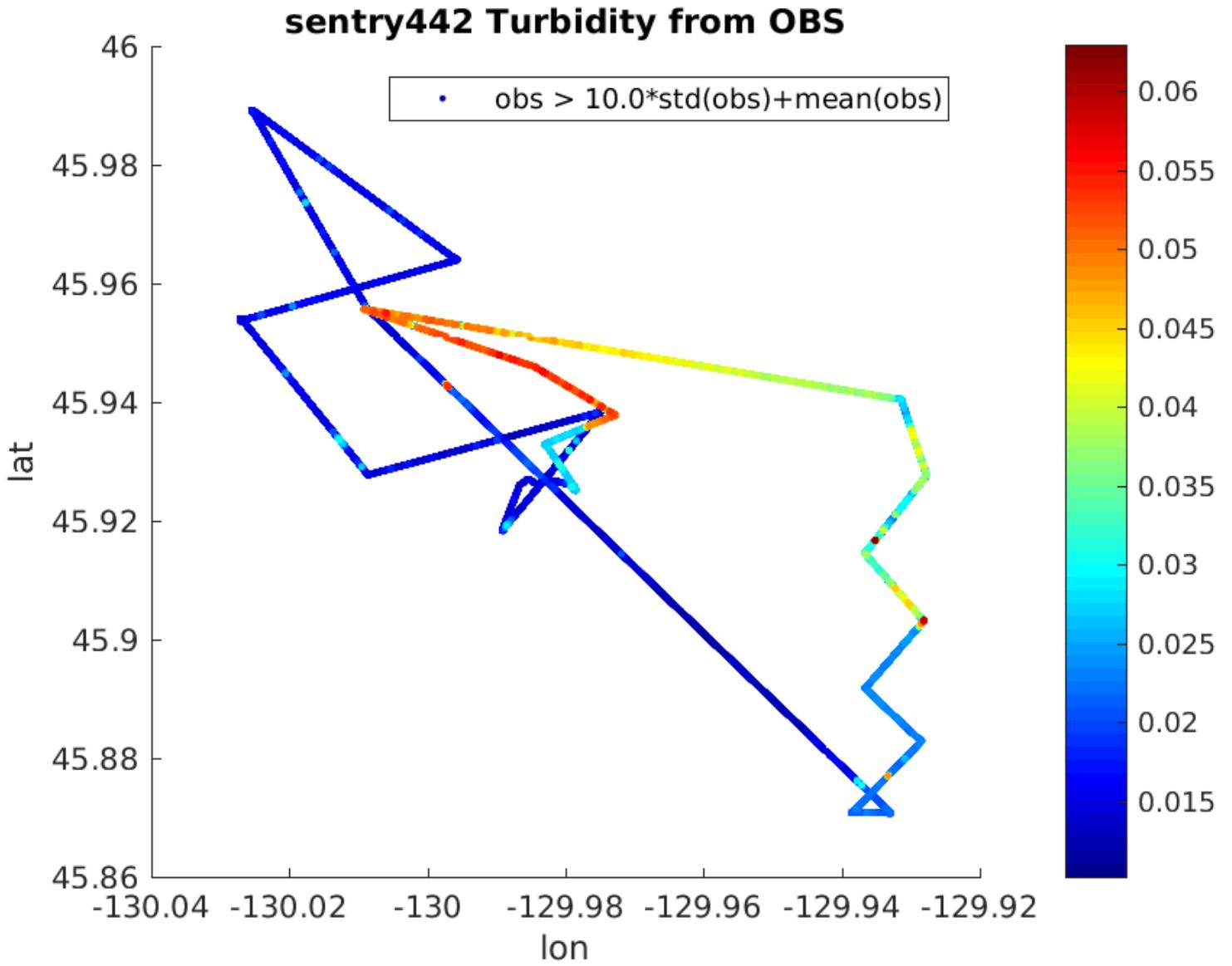
Figure 5: Optical backscatter on dive 442.

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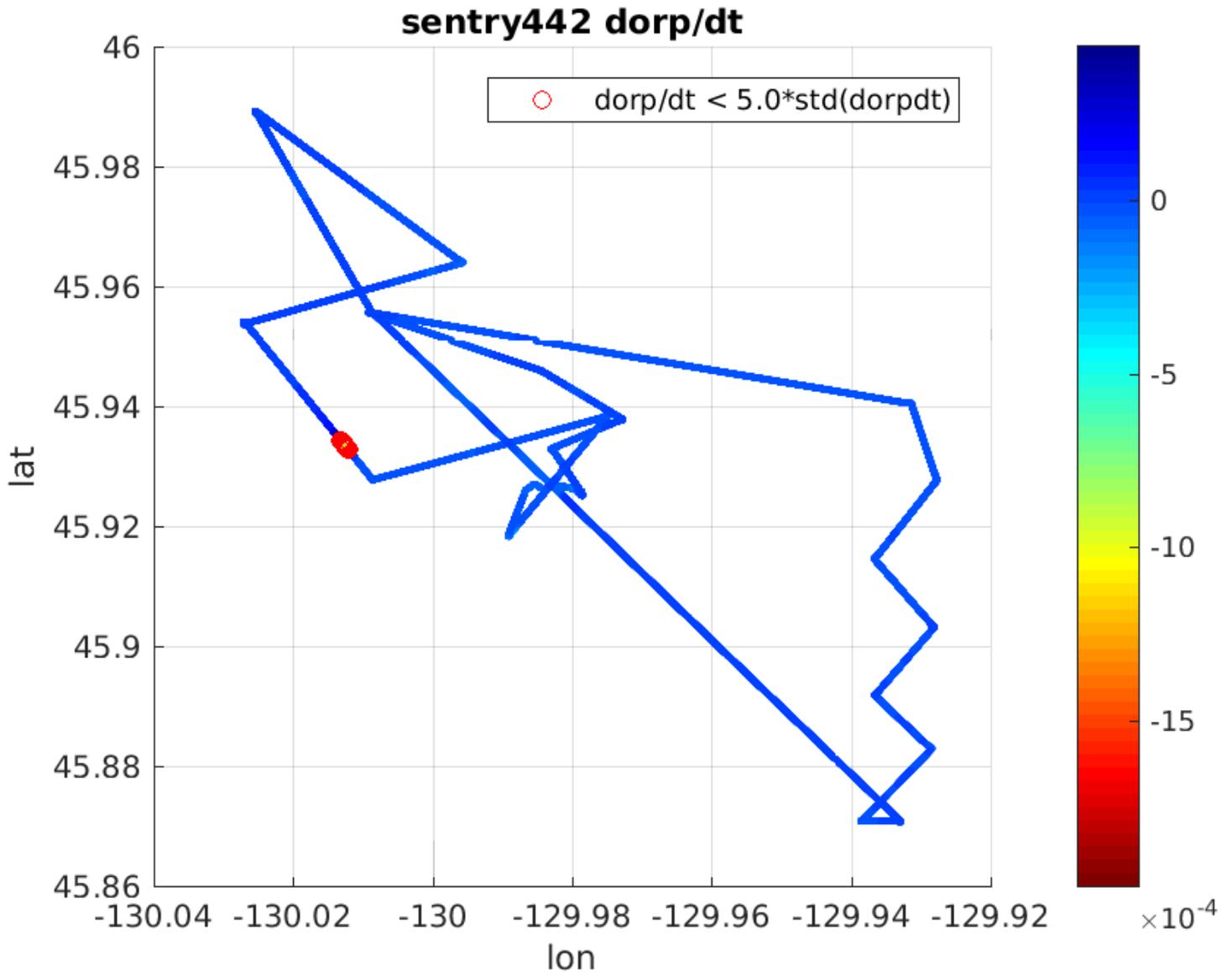
Figure 6: ORP sensor data during dive 442.

12
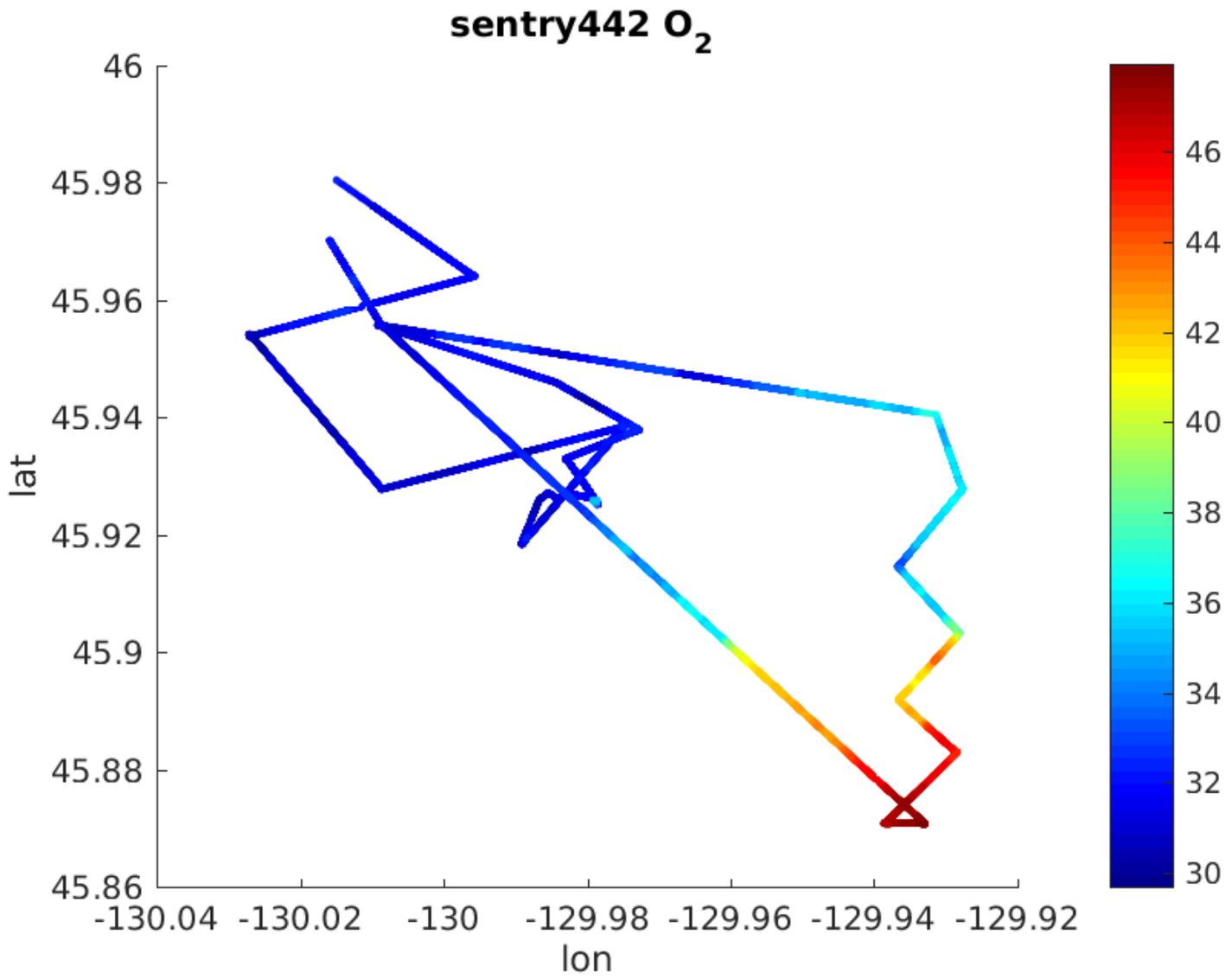
Figure 7: O2 sensor data during dive 442.
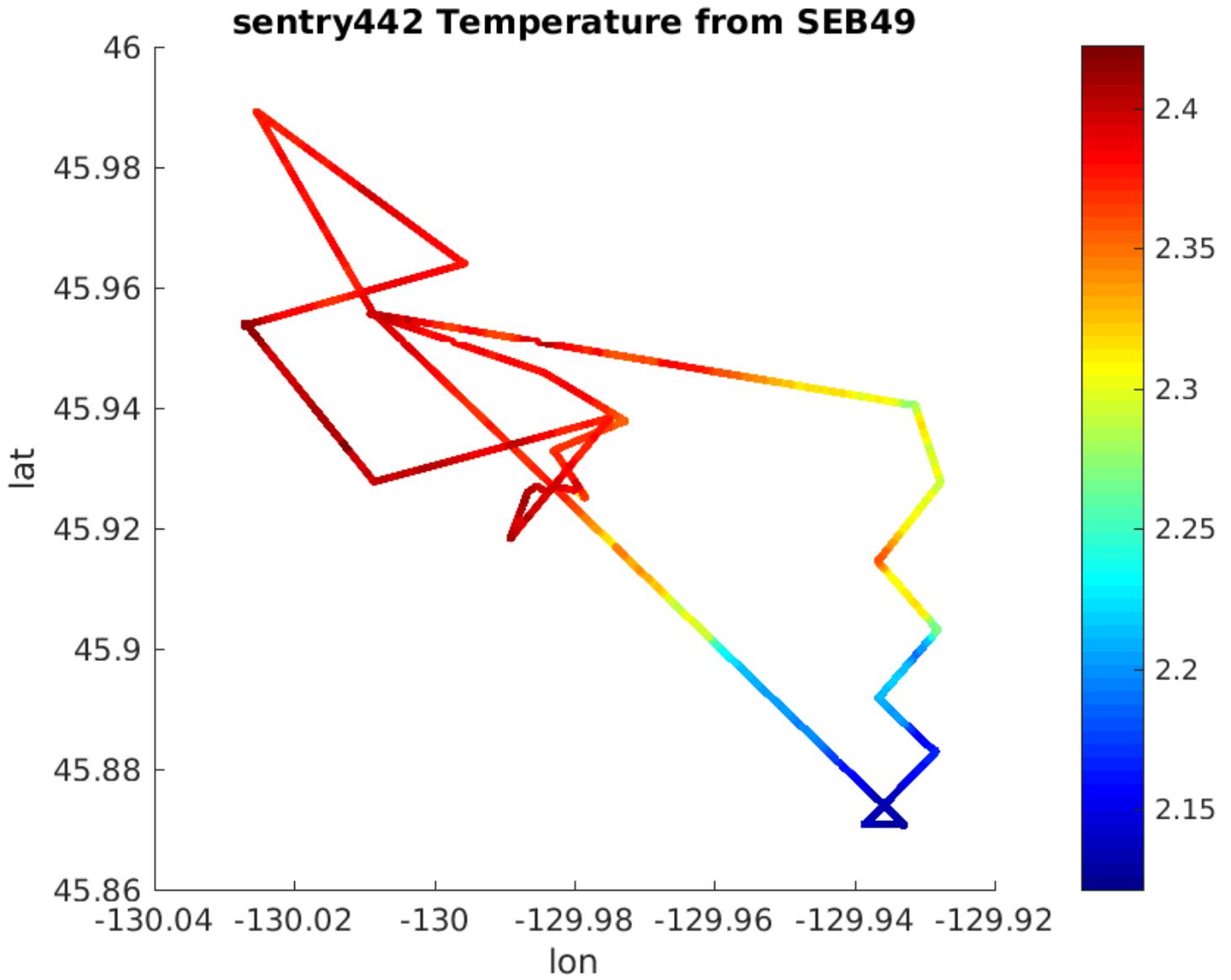
Figure 8: Temperature sensor data during dive 442.
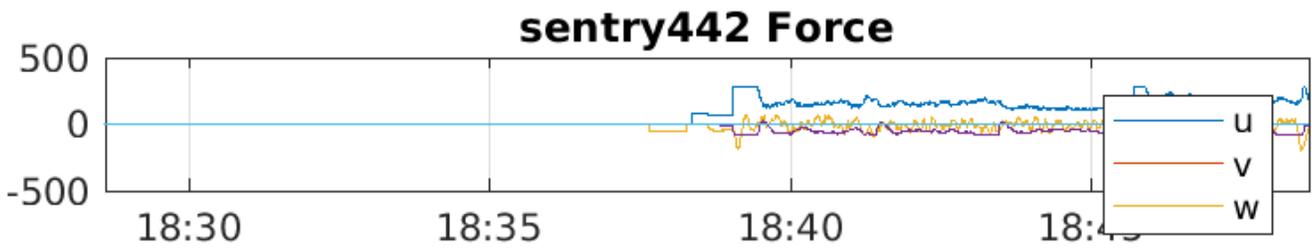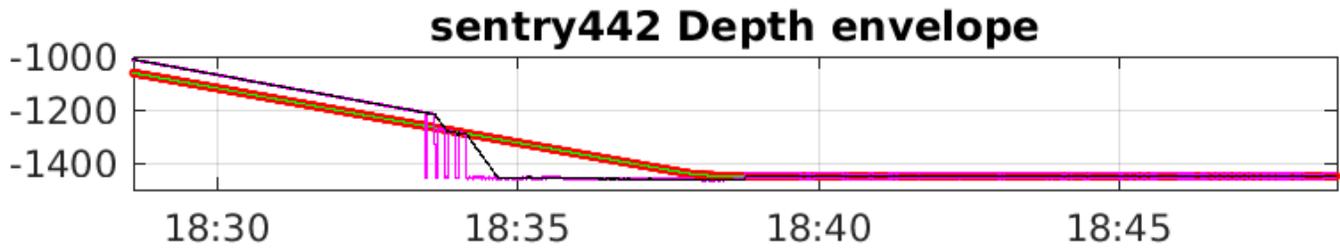
Figure 9: Bottom Approach for during dive 442.
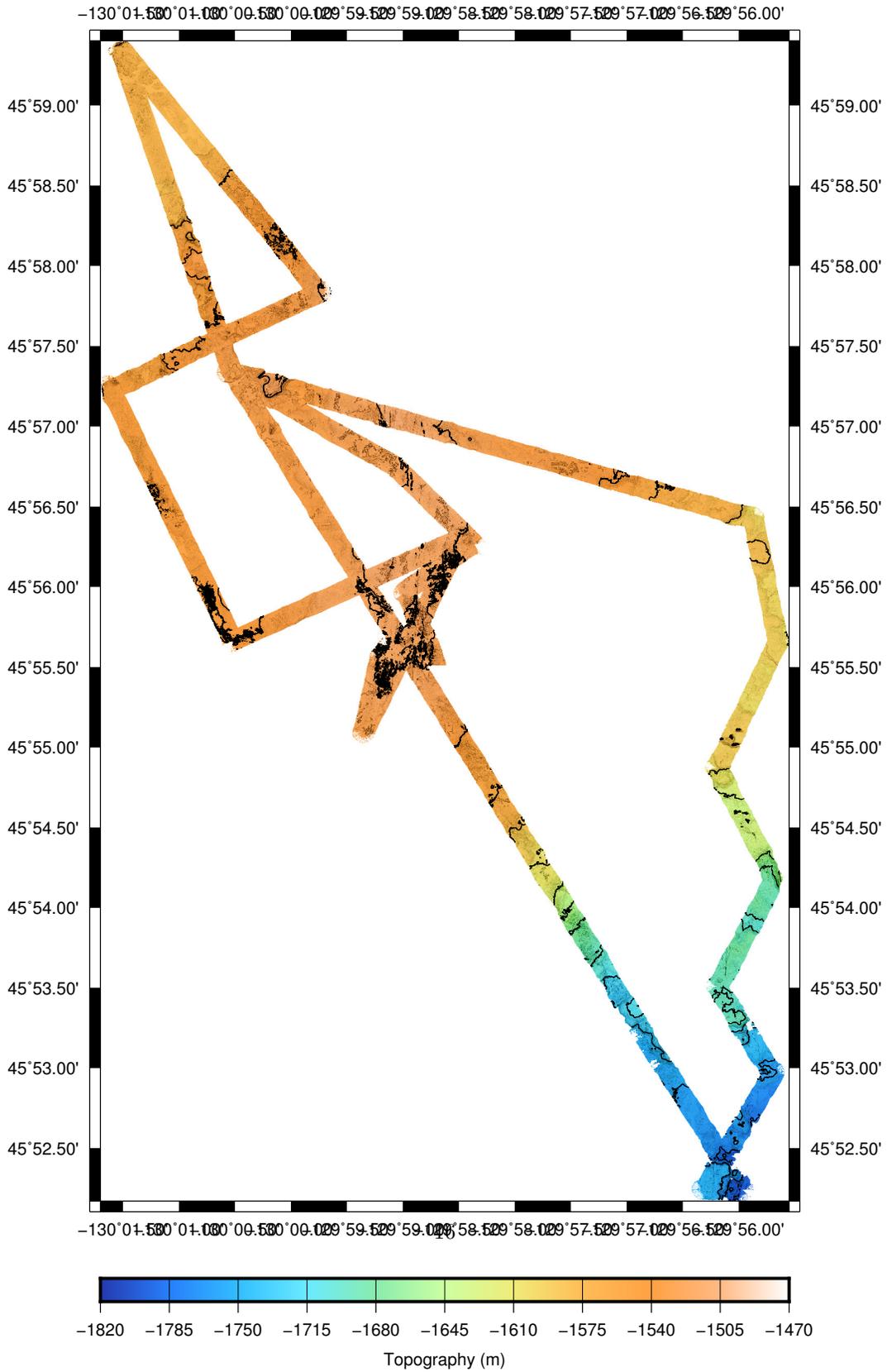
Figure 10: Processed multibeam data from dive 442

# Sentry 443 Dive Report
# DRAFT

**WHOI Sentry Operations Group**
Sean Kelley, Justin Fujii, Zac Berkowitz, Danik Forsman, Theo Guerin

Sentry Expedition Leader: Sean Kelley

Chief Scientist/PI: Scott Nooner, UNCW
Chief Scientist/PI: Bill Chadwick, OSU-HMSC

# Summary

**Weather:** winds were 5knots with nill seas for both launch and recovery.

**Reason for end of dive:** The dive was ended due to time.

# Vehicle Configuration

The science sensing suite for this dive was:

Table 3: Sentry Sensor Configuration

| Sensor |
| --- |
| APS 1540 Magnetometers (3) |
| Reson 7125 Multibeam Sonar |
| Seabird SBE49 CTD |
| Seapoint OBS |
| Anderaa optode model 4330 |
| 300kHz RDI DVL |
| Digital Still Camera |
| Blue View P900-90 Forward Looking Sonar |
| IXEA PHINS |
| Reson Sound Velocity Probe |
| NOAA PMEL MAPR |
| NOAA PMEL ORP Sensor |

# Important Positions

**Dive Origin:** 45 45.0000 -130 -12.0000

**Launch Position:** sentry443 launch position: 45 57.366'N 130 0.510'W

# Narrative

Sentry443 was the second dive of the cruise at axial caldera. Continuing the large survey pattern around the caldera. The Sentry fly away system was not used for launch as Jason was not in the water operating during the Sentry launch. This mission was comprised of three large loops around the caldera to the north, west, and south east, covering 73kilometers. The first two loops completed as expected, with the mission manually aborted at the end of the third loop. Due to time constraints and diminished battery capacity, the mission was aborted early. Aborting the mission early avoided Sentry running out of battery 7km away from the ship. The recovery required the Sentry tracklines to be shifted 300 meters west of the ship. This effort worked well, with no major movement for the vessel for recovery.

## Issues

None

## Chief Scientist Comments

None

## Dive Statistics

### 0.3    sentry443 Summary

sentry443 Summary
Origin: 45.750000 -130.200000
Origin: 45 45.000'N 130 12.000'W
Launch: 2017/07/17 03:44:48
Survey start: 2017/07/17 04:20:10
Survey start: Lat:45.955898 Lon:-130.008626
Survey start: Lat:45 57.354'N Lon:130 0.518'W
Survey end: 2017/07/18 02:06:45
Survey end: Lat:45.935026 Lon:-129.983952
Survey end: Lat:45 56.102'N Lon:129 59.037'W
Ascent begins: 2017/07/18 02:06:45
On the surface: 2017/07/18 02:34:38
On deck: 2017/07/18 02:48:22
descent rate: 41.3 m/min
ascent rate: 51.9 m/min
survey time: 21.8 hours
deck-to-deck time 23.1 hours
Mean survey depth: 1477m
Mean survey height: 64m
distance travelled: 73.29km
average speed; 0.93m/s
average speed during photo runs: 0.11 m/s over 0.01 km
average speed during multibeam runs: 0.94 m/s over 73.28 km
total vertical during survey: 5624m
Battery energy at launch: 20.5 kwhr
Battery energy at survey end: 2.7 kwhr
Battery energy on deck: 2.5 kwhr

## Sensor Information

This is a recently added section with selected sensor metadata. This section will be expanded in coming months. Additional data is available in the sentryxxx/nav-sci/proc directory within the sentryxxx_config

matlab structure as well as in ascii text logs in sentryxxx/metadata. At present metadata is not yet automatically collected on all sensors.

## 0.4   sentry443 Devices

| Instrument | Model | Serial Num. | Comments | Config File |
|---|---|---|---|---|
| USBL | Sonardyne AvTrak2 | | | `avtrak_20170717_0128.cfg` |
| DVL | RDI Navigator (300kHz) | 727-2000-00M | CX: 1, WP: 0 | `dvl300_20170717_0128.cfg` |
| CTD | SBE 49 | 222 | | `sbe49_20170717_0129.cfg` |
| SAIL | obs A/D | 13 | A: 5, G: 1.00, O: 0 | `a2d2-pods_20170717_0128.cfg` |
| | orp A/D | 9 | A: 3, G: 1.00, O: 0.002 | |

# Plots and Images

This section contains selected images of data products and plots of vehicle navigation and selected sensors.

Sentry443 dive tracks (Red) and planned survey (Black Line)

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Figure 11: Latitude/Longitude plot of Sentry dive 443 based on post-processed navigation.
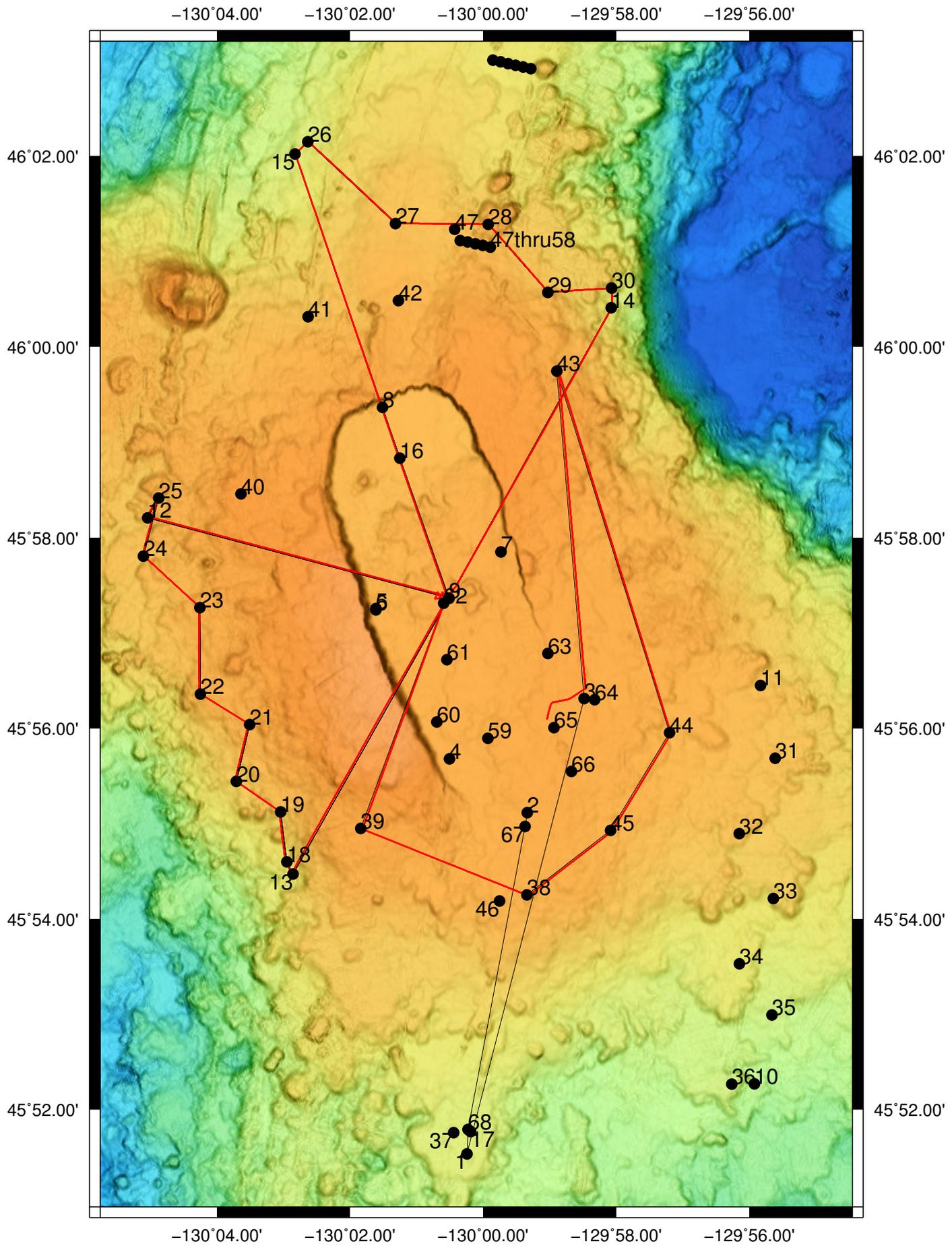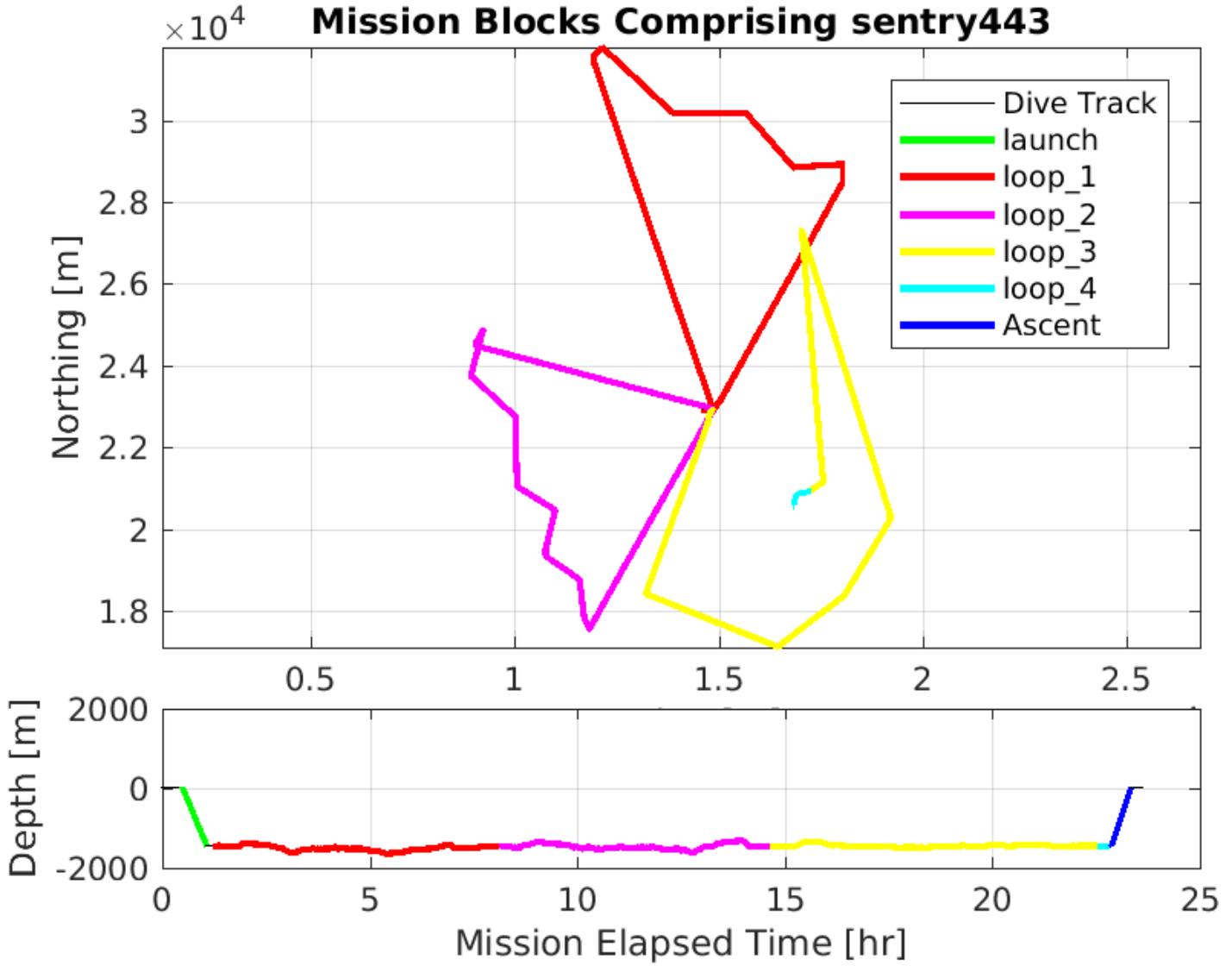
Figure 12: Mission Survey Blocks of Sentry dive 443

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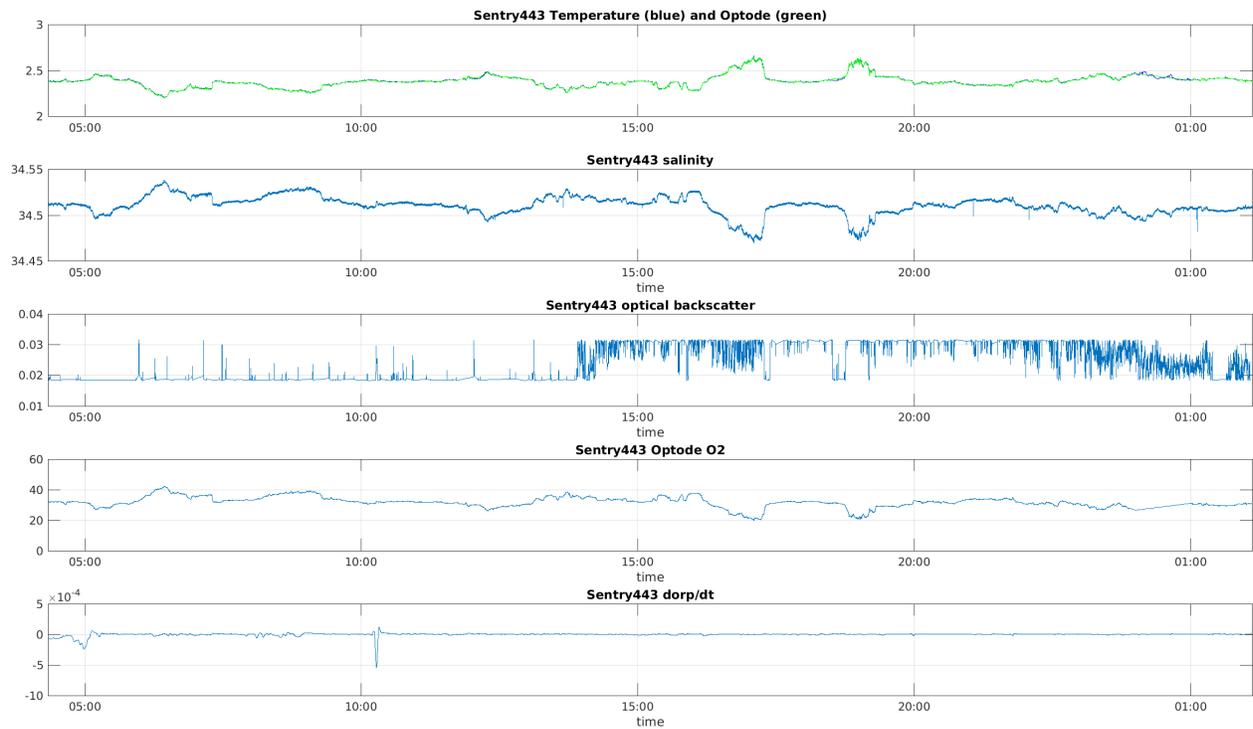
Figure 13: Time series plot of five of the basic sensors on Sentry, from top to bottom, temperature, salinity, optical backscatter, dissolved Oxygen, and ORP.
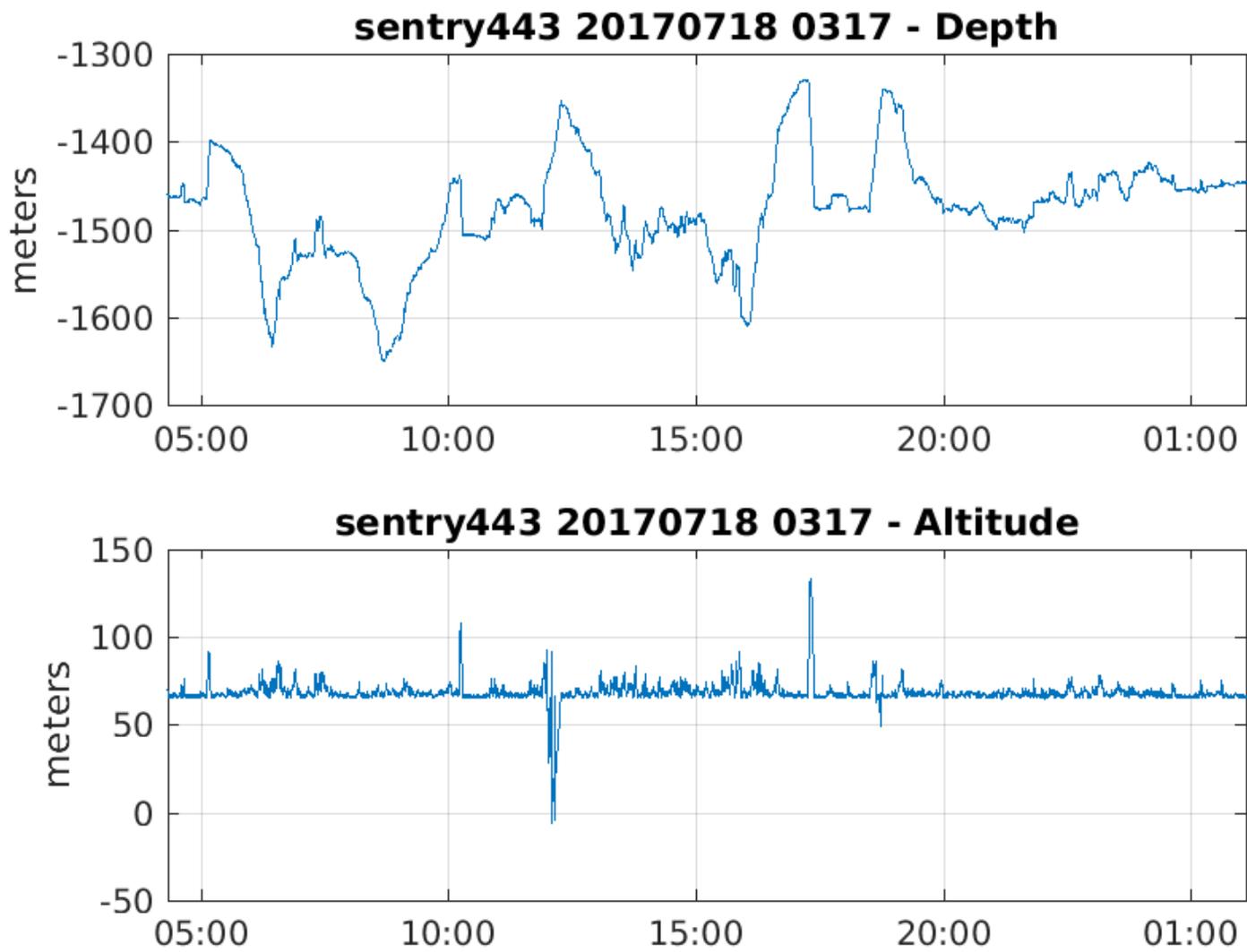
Figure 14: Depth and Altitude of Sentry during dive 443.
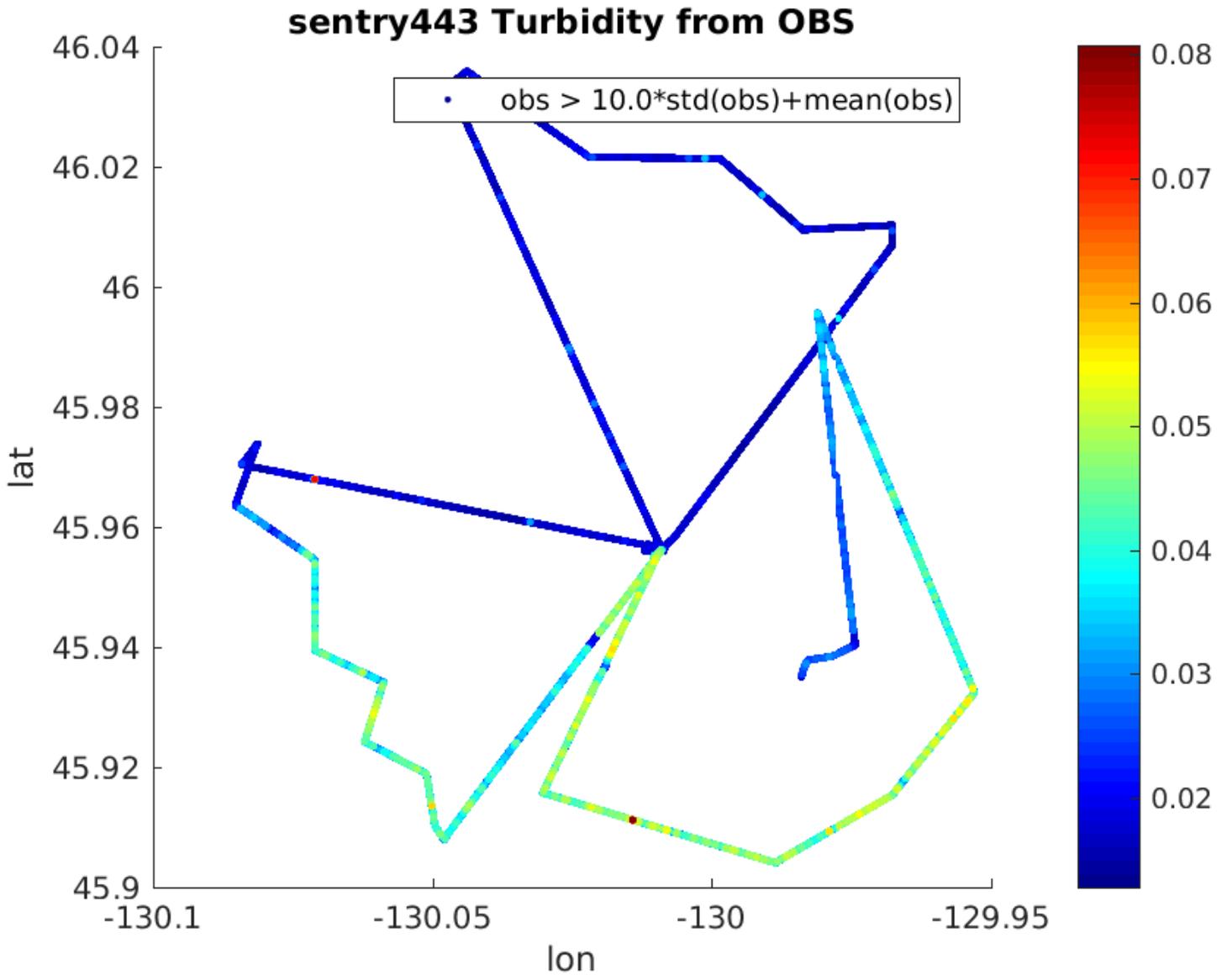
Figure 15: Optical backscatter on dive 443.
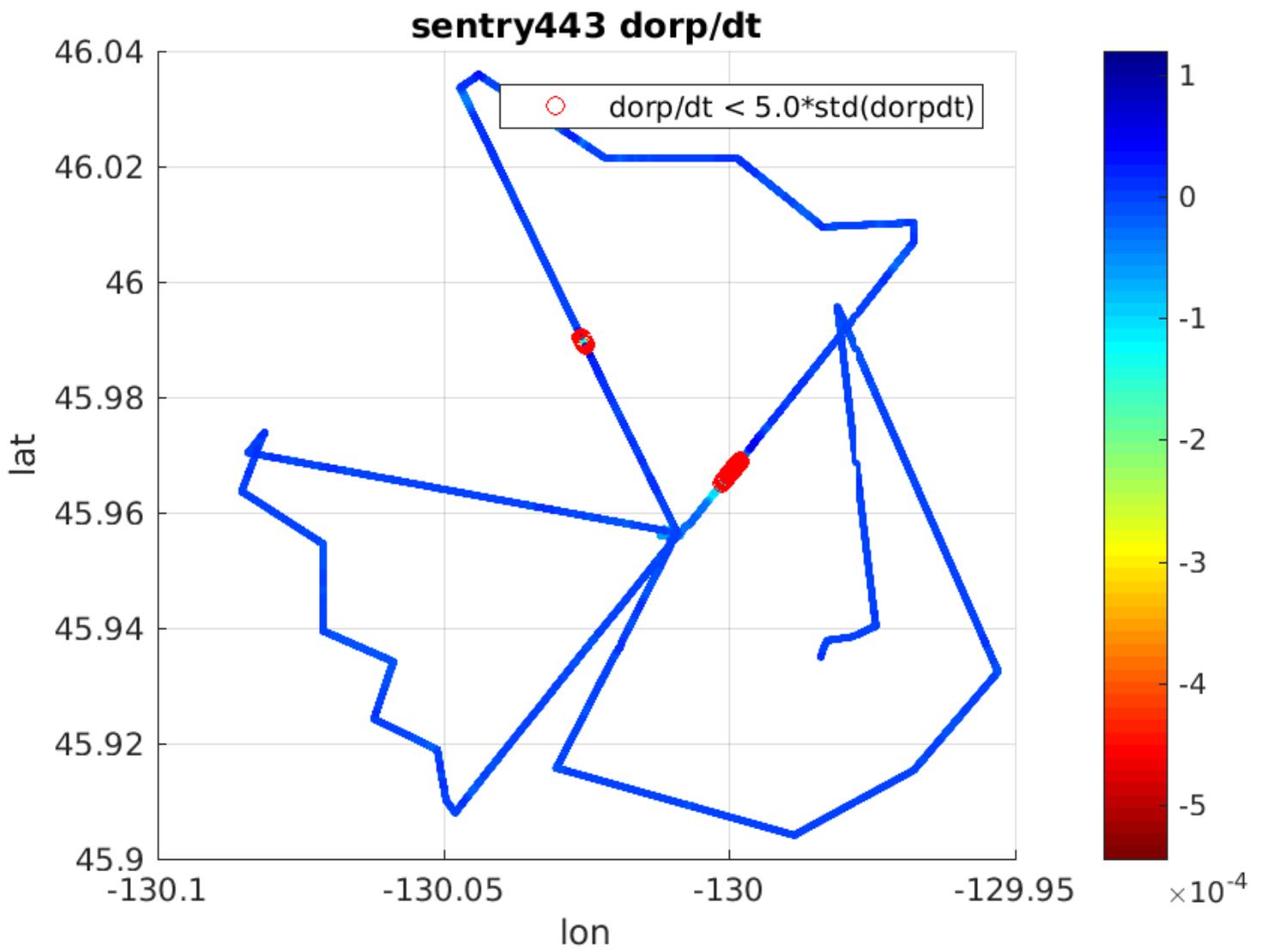
Figure 16: ORP sensor data during dive 443.

Figure 17: O2 sensor data during dive 443.
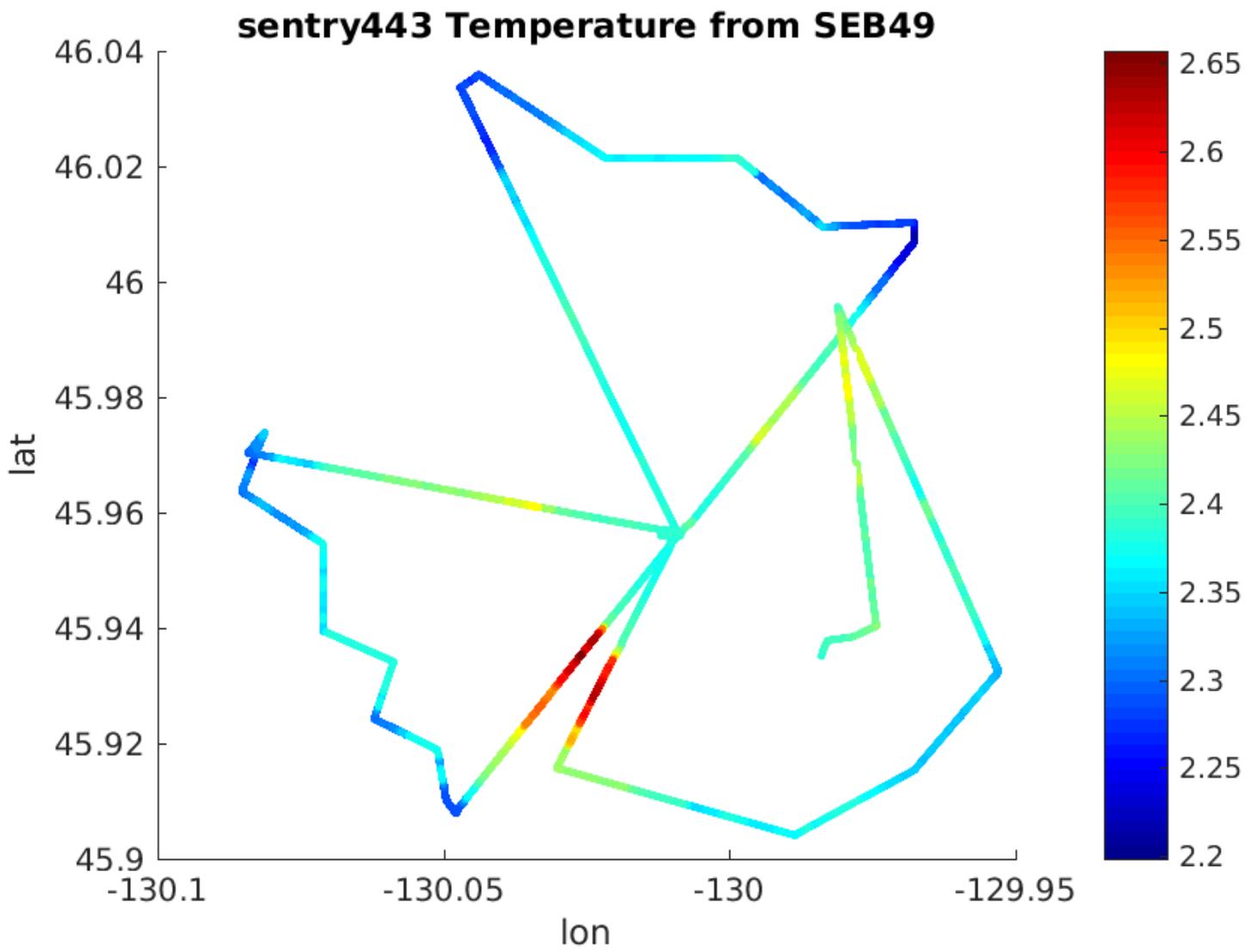
Figure 18: Temperature sensor data during dive 443.

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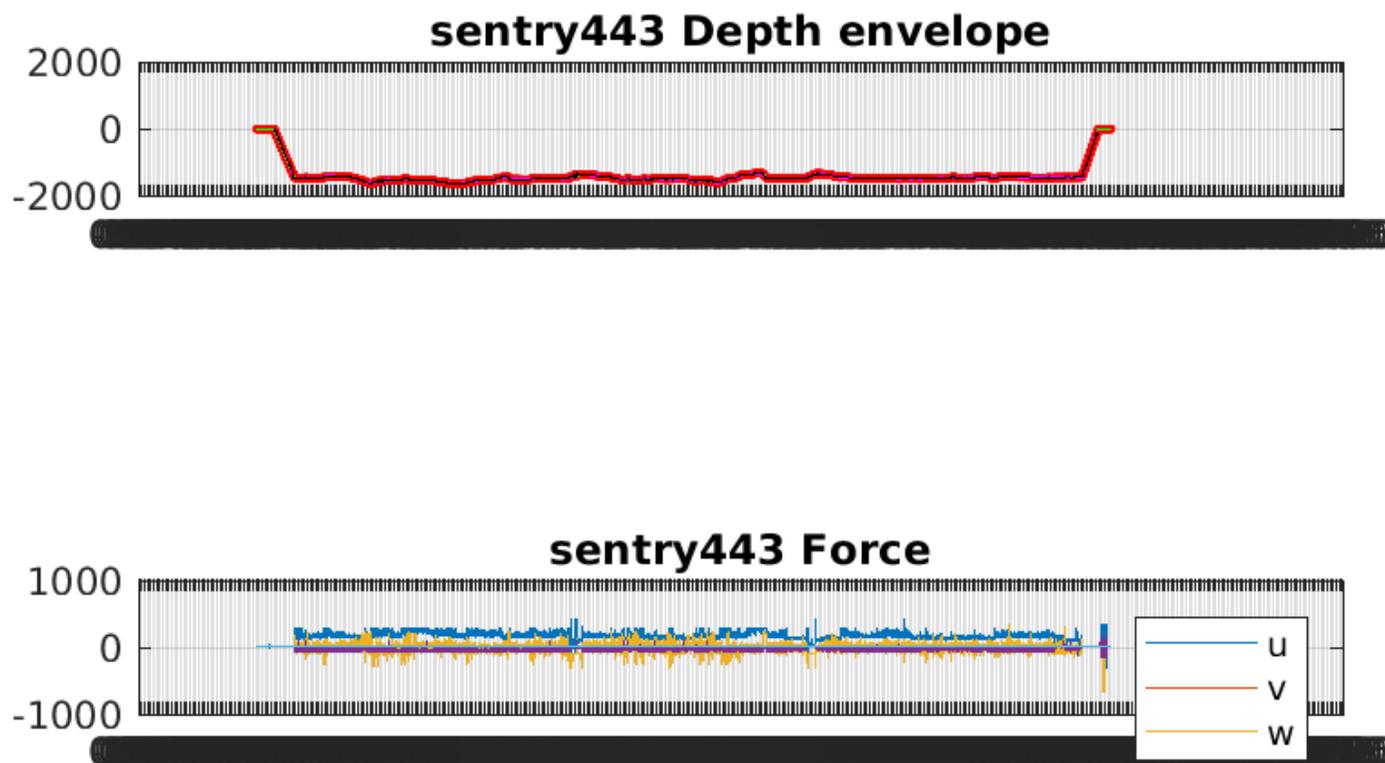
Figure 19: Bottom Approach for during dive 443.
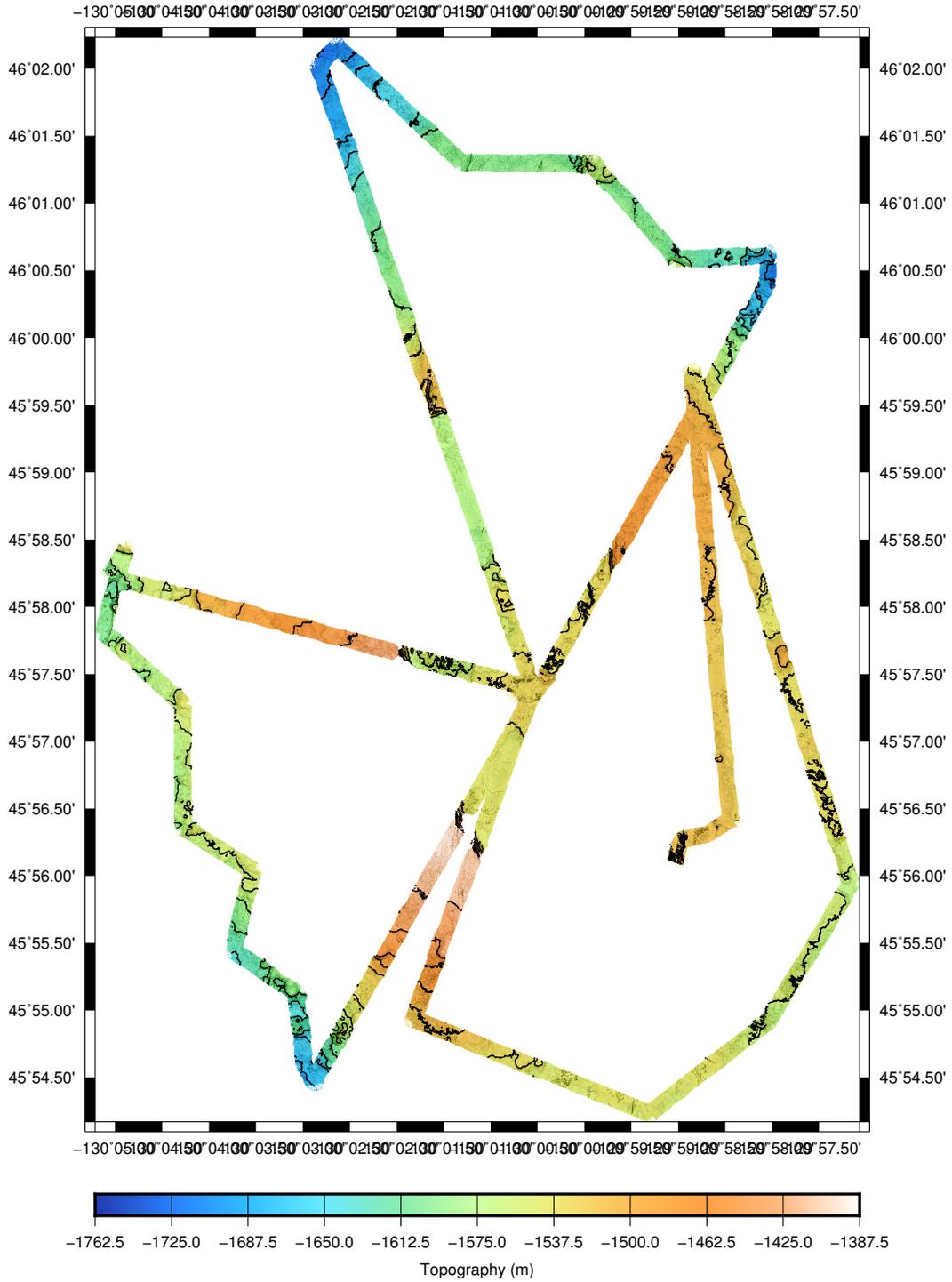
Figure 20: Processed multibeam data from dive 443

# Sentry 444 Dive Report
# DRAFT
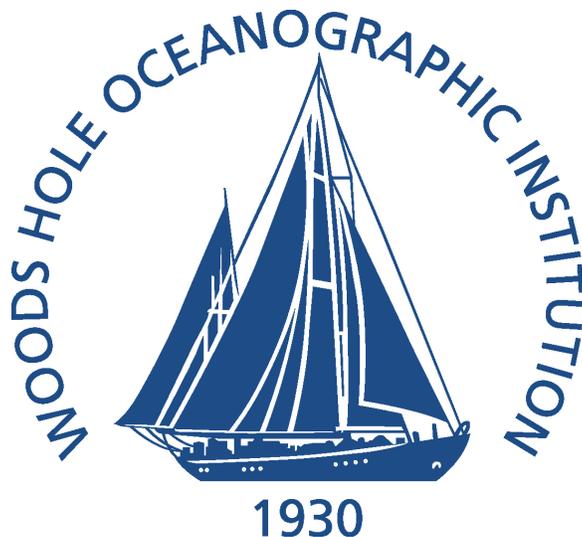
**WHOI Sentry Operations Group**
Sean Kelley, Justin Fujii, Zac Berkowitz, Danik Forsman, Theo Guerin

Sentry Expedition Leader: Sean Kelley

Chief Scientist/PI: Scott Nooner, UNCW
Chief Scientist/PI: Bill Chadwick, OSU-HMSC

# Summary

**Weather:** winds were 5knots with nill seas for both launch and recovery.

**Reason for end of dive:** Mission complete.

# Vehicle Configuration

The science sensing suite for this dive was:

Table 4: Sentry Sensor Configuration

| Sensor |
| --- |
| APS 1540 Magnetometers (3) |
| Reson 7125 Multibeam Sonar |
| Seabird SBE49 CTD |
| Seapoint OBS |
| Anderaa optode model 4330 |
| 300kHz RDI DVL |
| Digital Still Camera |
| Blue View P900-90 Forward Looking Sonar |
| IXEA PHINS |
| Reson Sound Velocity Probe |
| NOAA PMEL MAPR |
| NOAA PMEL ORP Sensor |

# Important Positions

**Dive Origin:** 45 45.0000 -130 -12.0000

**Launch Position:** sentry444 launch position: 45 55.116'N 129 59.336'W

# Narrative

Sentry444 was the third dive of the cruise at axial caldera. This survey focused on capturing the southern most targets.

This dive completed as planned with no issues. Recovery was delayed to allow ROV jason to recover before the Sentry recovery, due to issues with the ROV. This shift in the sentry recovery time required several actions on the Sentry operations team to ensure this would be successful. With the risk of running out of tracklines causing an immediate abort, Sentry's forward speed was changed from 1m/s to 0.5m/s to buy more time on the bottom. Sentry also required a navigation shift 300m east to avoid driving through the jason work site. These two actions were implemented without any issues. Sentry finally ended at the 75m x 75m survey box at the end of the mission survey 800m north of the jason recovery. Sentry eventually

aborted due to the XR deadman timer running out.

Crane operations during the recovery were poor and need adjustment before the next launch. Inadequate line up of Sentry over the cradle made recovery difficult and potentially damaging to the vehicle.

## Issues

None

## Chief Scientist Comments

None

## Dive Statistics

### 0.5    sentry444 Summary

sentry444 Summary
Origin: 45.750000 -130.200000
Origin: 45 45.000'N 130 12.000'W
Launch: 2017/07/18 21:51:07
Survey start: 2017/07/18 22:26:19
Survey start: Lat:45.917650 Lon:-129.988023
Survey start: Lat:45 55.059'N Lon:129 59.281'W
Survey end: 2017/07/19 23:14:05
Survey end: Lat:45.940715 Lon:-130.013343
Survey end: Lat:45 56.443'N Lon:130 0.801'W
Ascent begins: 2017/07/19 23:14:05
On the surface: 2017/07/19 23:43:24
On deck: 2017/07/20 00:02:52
descent rate: 41.5 m/min
ascent rate: 51.9 m/min
survey time: 24.8 hours
deck-to-deck time 26.2 hours
Mean survey depth: 1500m
Mean survey height: 60m
distance travelled: 82.29km
average speed; 0.92m/s
average speed during photo runs: NaN m/s over 0.00 km
average speed during multibeam runs: 0.93 m/s over 82.29 km
total vertical during survey: 5924m
Battery energy at launch: 20.4 kwhr
Battery energy at survey end: 2.8 kwhr

Battery energy on deck: 2.6 kwhr

# Sensor Information

This is a recently added section with selected sensor metadata. This section will be expanded in coming months. Additional data is available in the sentryxxx/nav-sci/proc directory within the sentryxxx_config matlab structure as well as in ascii text logs in sentryxxx/metadata. At present metadata is not yet automatically collected on all sensors.

## 0.6  sentry444 Devices

| Instrument | Model | Serial Num. | Comments | Config File |
|---|---|---|---|---|
| USBL | Sonardyne AvTrak2 | | | `avtrak_20170718_1922.cfg` |
| DVL | RDI Navigator (300kHz) | 727-2000-00M | CX: 1, WP: 0 | `dvl300_20170718_1923.cfg` |
| CTD | SBE 49 | 222 | | `sbe49_20170718_1923.cfg` |
| SAIL | obs A/D | 13 | A: 5, G: 1.00, O: 0 | `a2d2-pods_20170718_1923.cfg` |
| | orp A/D | 9 | A: 3, G: 1.00, O: 0.002 | |

# Plots and Images

This section contains selected images of data products and plots of vehicle navigation and selected sensors.

Sentry444 dive tracks (Red) and planned survey (Black Line)

Figure 21: Latitude/Longitude plot of Sentry dive 444 based on post-processed navigation.
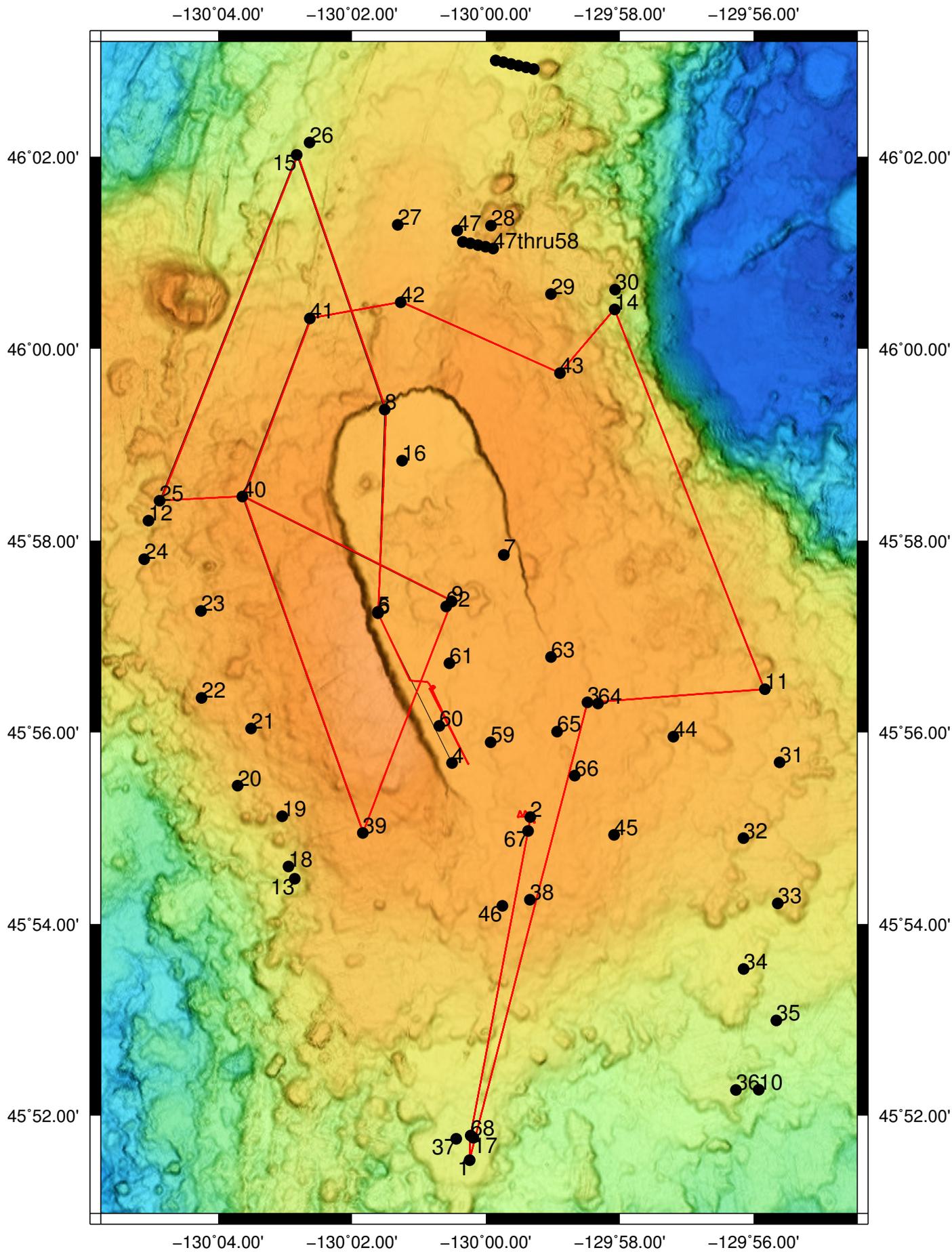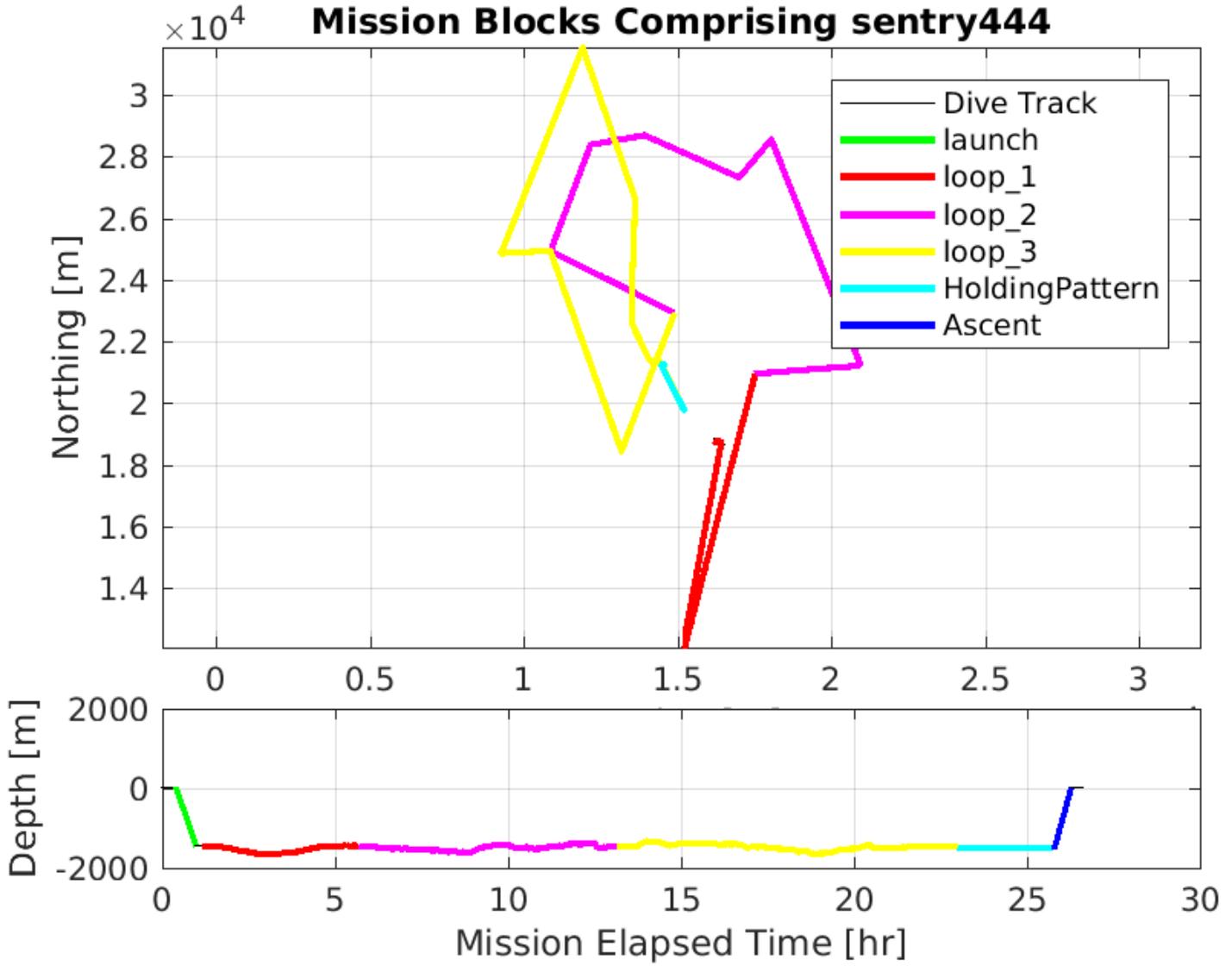
Figure 22: Mission Survey Blocks of Sentry dive 444
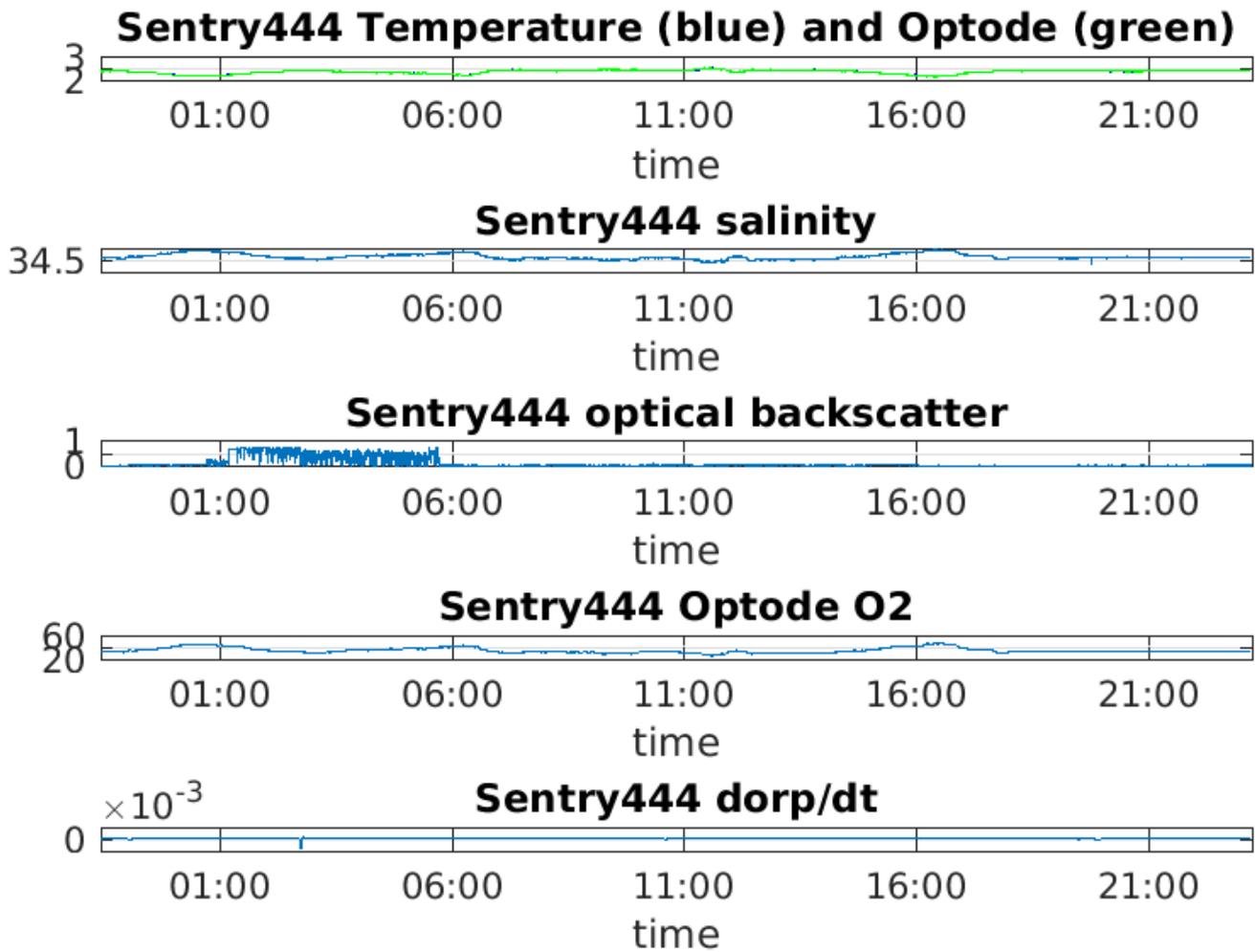
Figure 23: Time series plot of five of the basic sensors on Sentry, from top to bottom, temperature, salinity, optical backscatter, dissolved Oxygen, and ORP.
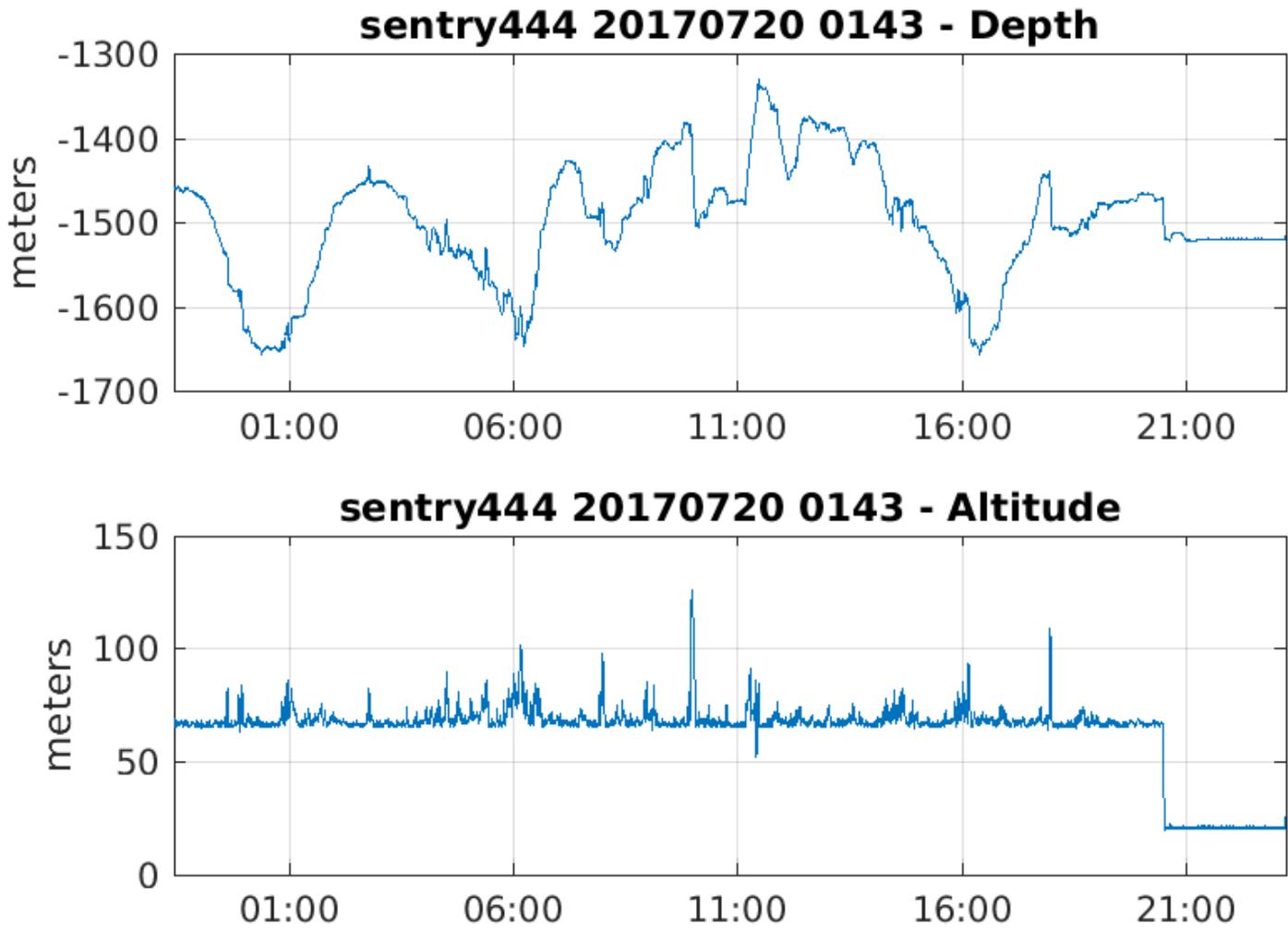
Figure 24: Depth and Altitude of Sentry during dive 444.
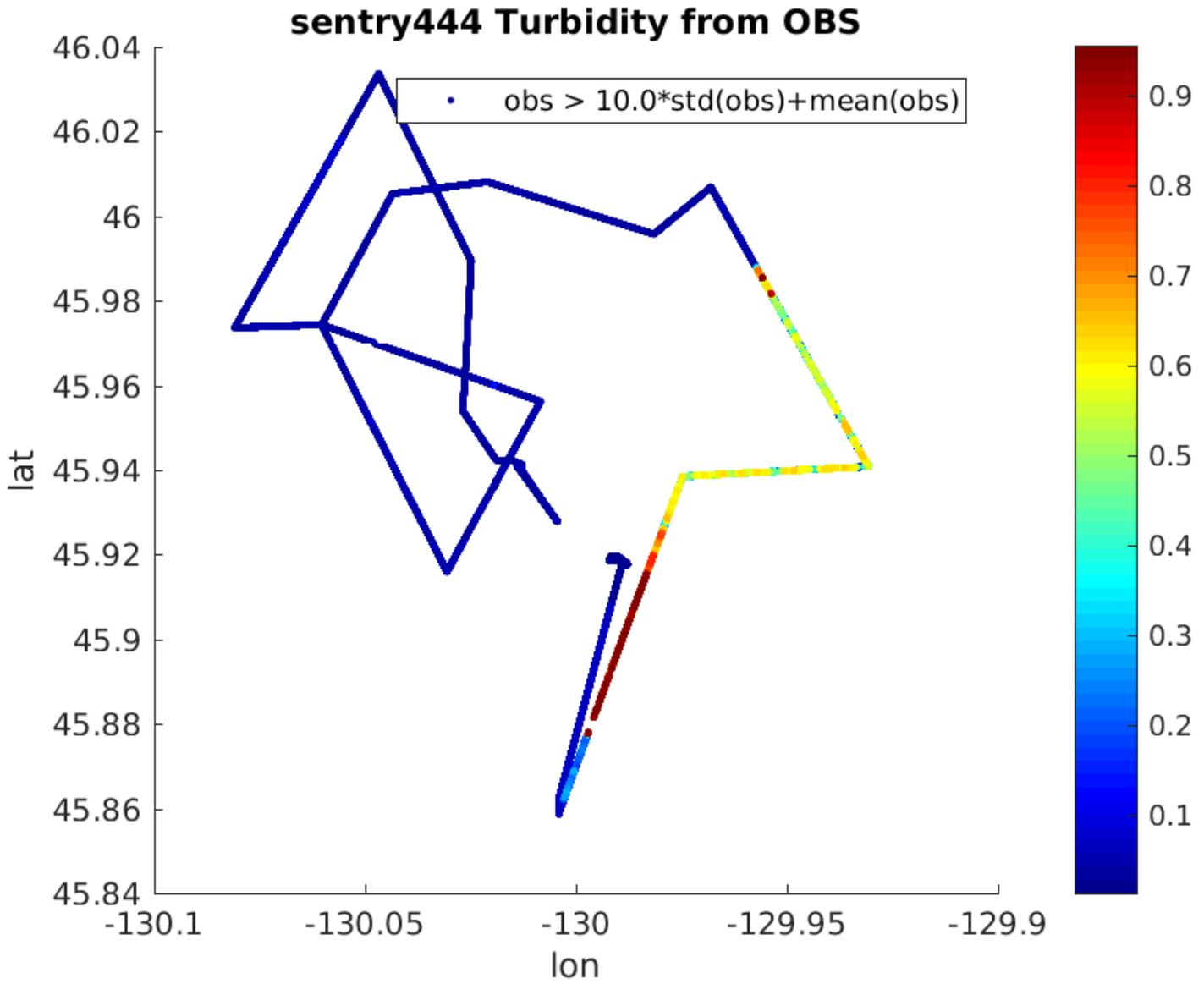
Figure 25: Optical backscatter on dive 444.
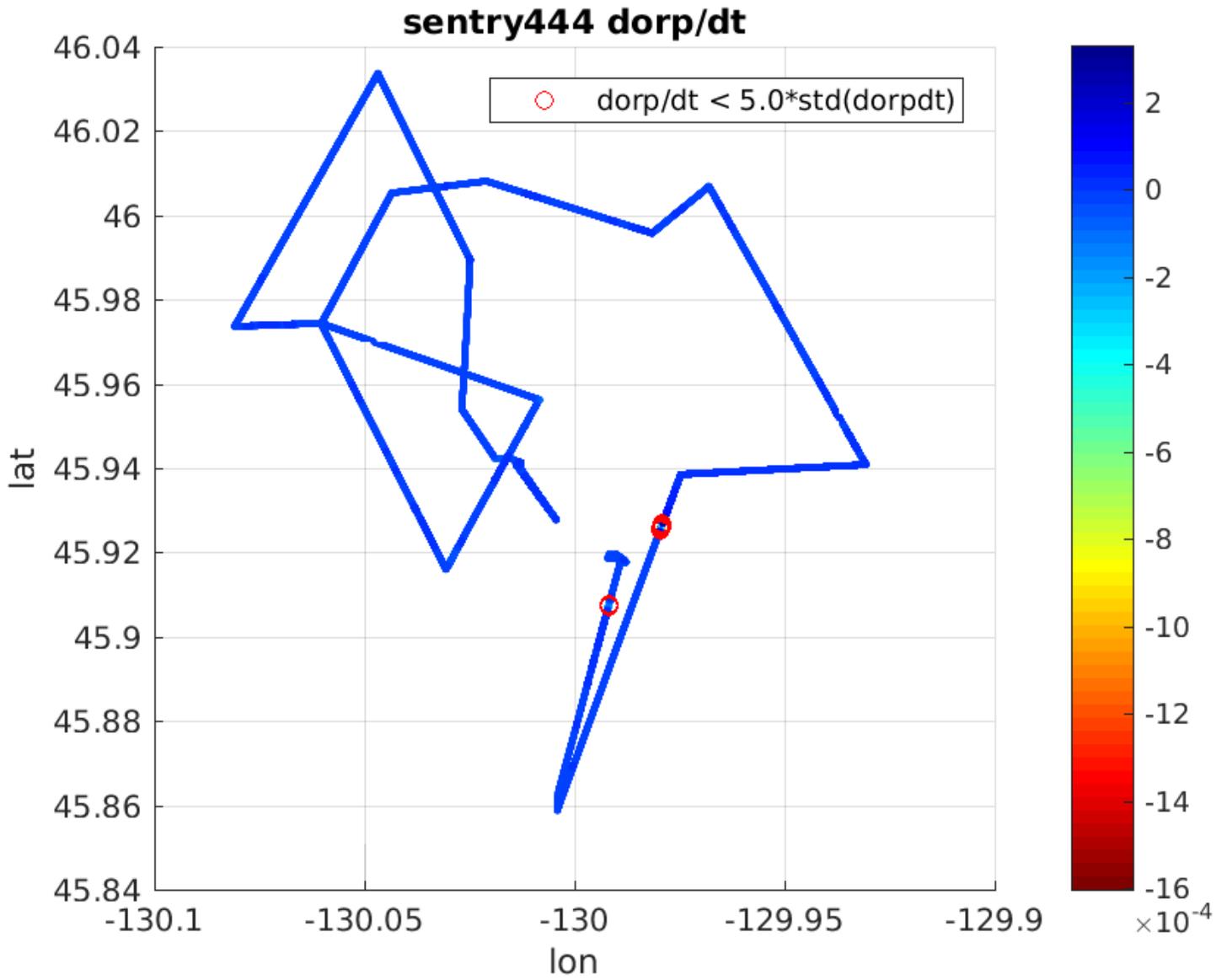
Figure 26: ORP sensor data during dive 444.

Figure 27: O2 sensor data during dive 444.
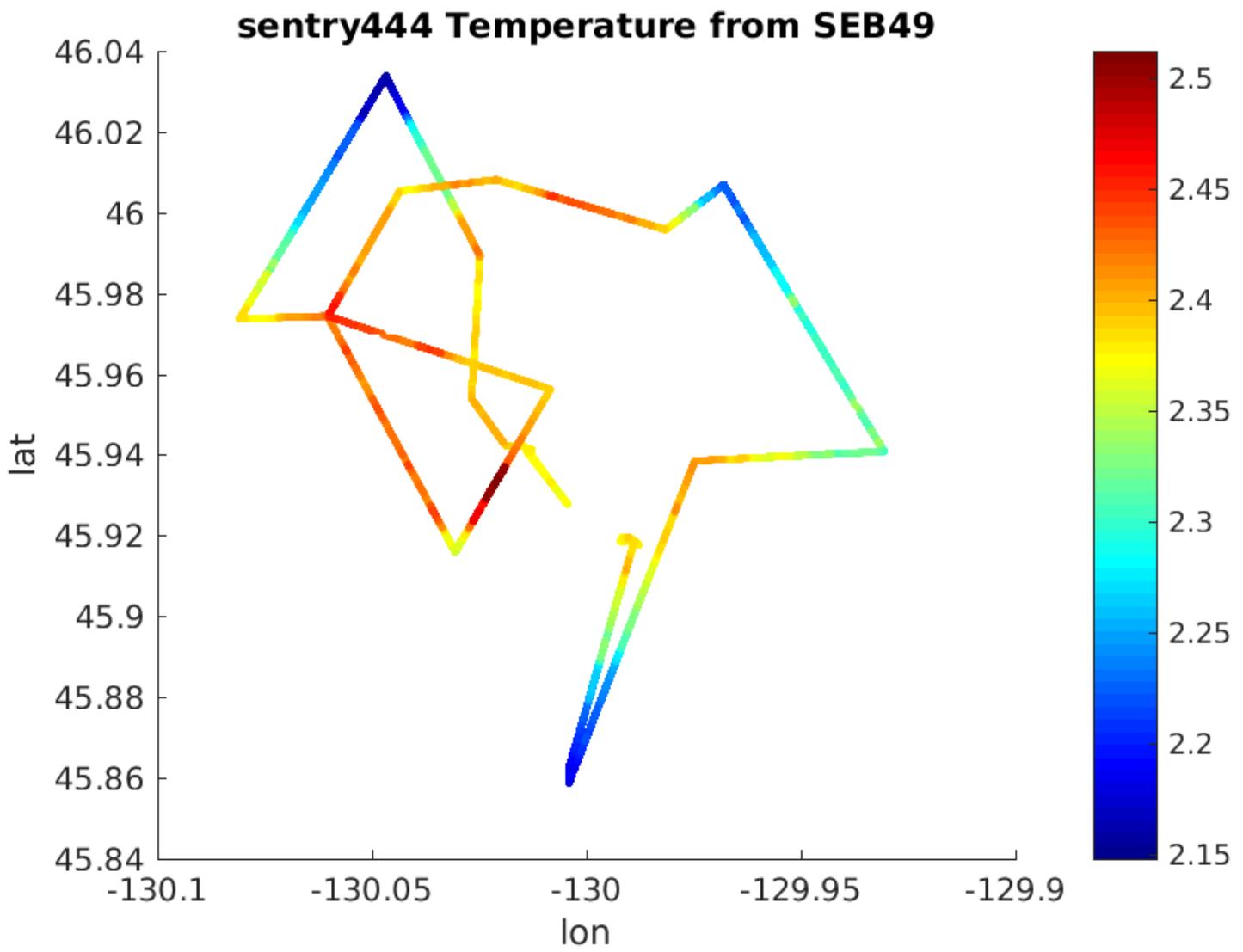
Figure 28: Temperature sensor data during dive 444.
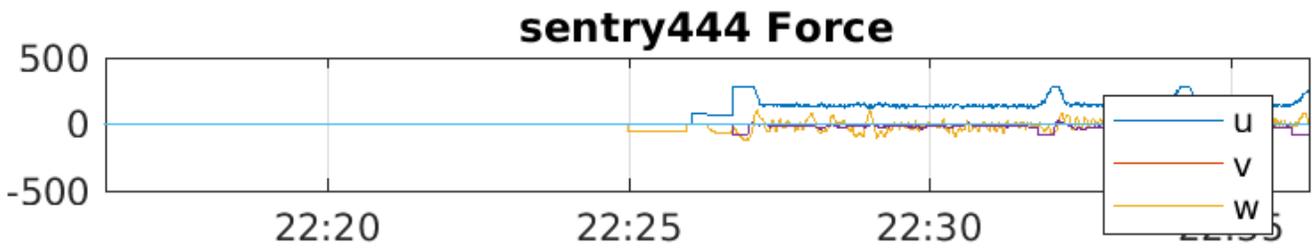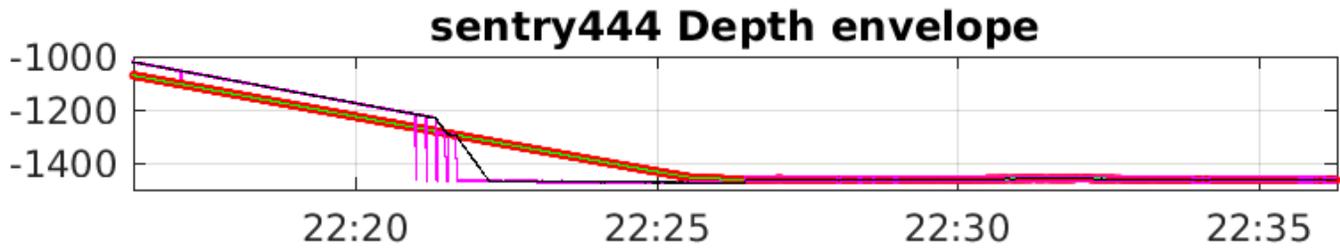
Figure 29: Bottom Approach for during dive 444.
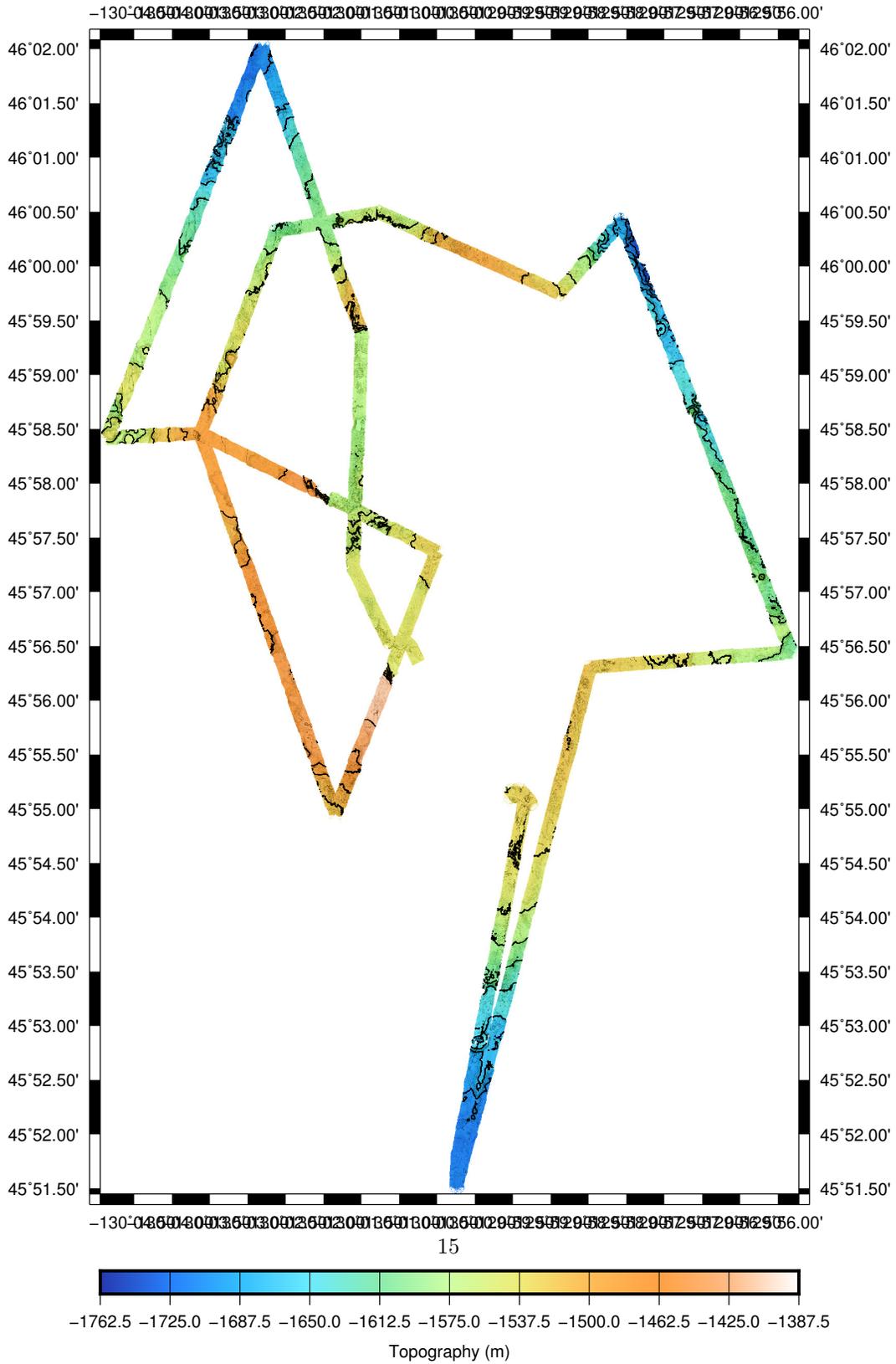
Figure 30: Processed multibeam data from dive 444

# Sentry 445 Dive Report
# DRAFT

**WHOI Sentry Operations Group**
Sean Kelley, Justin Fujii, Zac Berkowitz, Danik Forsman, Theo Guerin

Sentry Expedition Leader: Sean Kelley

Chief Scientist/PI: Scott Nooner, UNCW
Chief Scientist/PI: Bill Chadwick, OSU-HMSC

# Summary

**Weather:** winds were 10 to 15 knots with 2 to 3 foot seas for launch. 18 knot winds with 4 to 5 foot swell for recovery.

**Reason for end of dive:** Mission complete.

# Vehicle Configuration

The science sensing suite for this dive was:

Table 5: Sentry Sensor Configuration

| Sensor |
| --- |
| APS 1540 Magnetometers (3) |
| Reson 7125 Multibeam Sonar |
| Seabird SBE49 CTD |
| Seapoint OBS |
| Anderaa optode model 4330 |
| 300kHz RDI DVL |
| Digital Still Camera |
| Blue View P900-90 Forward Looking Sonar |
| IXEA PHINS |
| Reson Sound Velocity Probe |
| NOAA PMEL MAPR |
| NOAA PMEL ORP Sensor |

# Important Positions

**Dive Origin:** 45 45.0000 -130 -12.0000

**Launch Position:** sentry445 launch position: 45 55.068'N 129 59.547'W

# Narrative

Sentry445 was the fourth dive of the cruise at axial caldera. This survey focused on capturing some of the southern most targets.

Sentry445 was planned to be a much shorter dive then previous dives with only 11 hours of survey to complete. On descent, USBL positions and acomms were out of range until sentry reached 700m. This was in part due to the Sentry fly away system used on launch, that drives the vehicle away from the ship. The USBL system has a narrow cone for tracking, which does not work well at a high degree angle.

Overall, the mission went well and without any issues.

Recovery conditions were poor with high winds and large swells. Vessel movement through the water was poorly setup and made Sentry surface driving difficult. After several failed attempts at driving sentry in, Sentry was finally recovered.

## Issues

None

## Chief Scientist Comments

None

# Dive Statistics

## 0.7 sentry445 Summary

sentry445 Summary
Origin: 45.750000 -130.200000
Origin: 45 45.000'N 130 12.000'W
Launch: 2017/07/20 22:56:01
Survey start: 2017/07/21 02:24:27
Survey start: Lat:45.918301 Lon:-129.991908
Survey start: Lat:45 55.098'N Lon:129 59.514'W
Survey end: 2017/07/21 14:19:05
Survey end: Lat:45.956882 Lon:-130.009736
Survey end: Lat:45 57.413'N Lon:130 0.584'W
Ascent begins: 2017/07/21 14:19:05
On the surface: 2017/07/21 14:48:20
On deck: 2017/07/21 15:14:00
descent rate: 7.0 m/min
ascent rate: 51.5 m/min
survey time: 11.9 hours
deck-to-deck time 16.3 hours
Mean survey depth: 1574m
Mean survey height: 64m
distance travelled: 40.29km
average speed; 0.94m/s
average speed during photo runs: NaN m/s over 0.00 km
average speed during multibeam runs: 0.95 m/s over 40.29 km
total vertical during survey: 2968m
Battery energy at launch: 20.7 kwhr
Battery energy at survey end: 9.9 kwhr
Battery energy on deck: 9.6 kwhr

# Sensor Information

This is a recently added section with selected sensor metadata. This section will be expanded in coming months. Additional data is available in the sentryxxx/nav-sci/proc directory within the sentryxxx_config matlab structure as well as in ascii text logs in sentryxxx/metadata. At present metadata is not yet automatically collected on all sensors.

## 0.8 sentry445 Devices

| Instrument | Model | Serial Num. | Comments | Config File |
|---|---|---|---|---|
| USBL | Sonardyne AvTrak2 | | | `avtrak_20170720_2242.cfg` |
| DVL | RDI Navigator (300kHz) | 727-2000-00M | CX: 1, WP: 0 | `dvl300_20170720_2243.cfg` |
| CTD | SBE 49 | 222 | | `sbe49_20170720_2243.cfg` |
| SAIL | obs A/D<br>orp A/D | 13<br>9 | A: 5, G: 1.00, O: 0<br>A: 3, G: 1.00, O: 0.002 | `a2d2-pods_20170720_2243.cfg` |

# Plots and Images

This section contains selected images of data products and plots of vehicle navigation and selected sensors.

Sentry445 dive tracks (Red) and planned survey (Black Line)
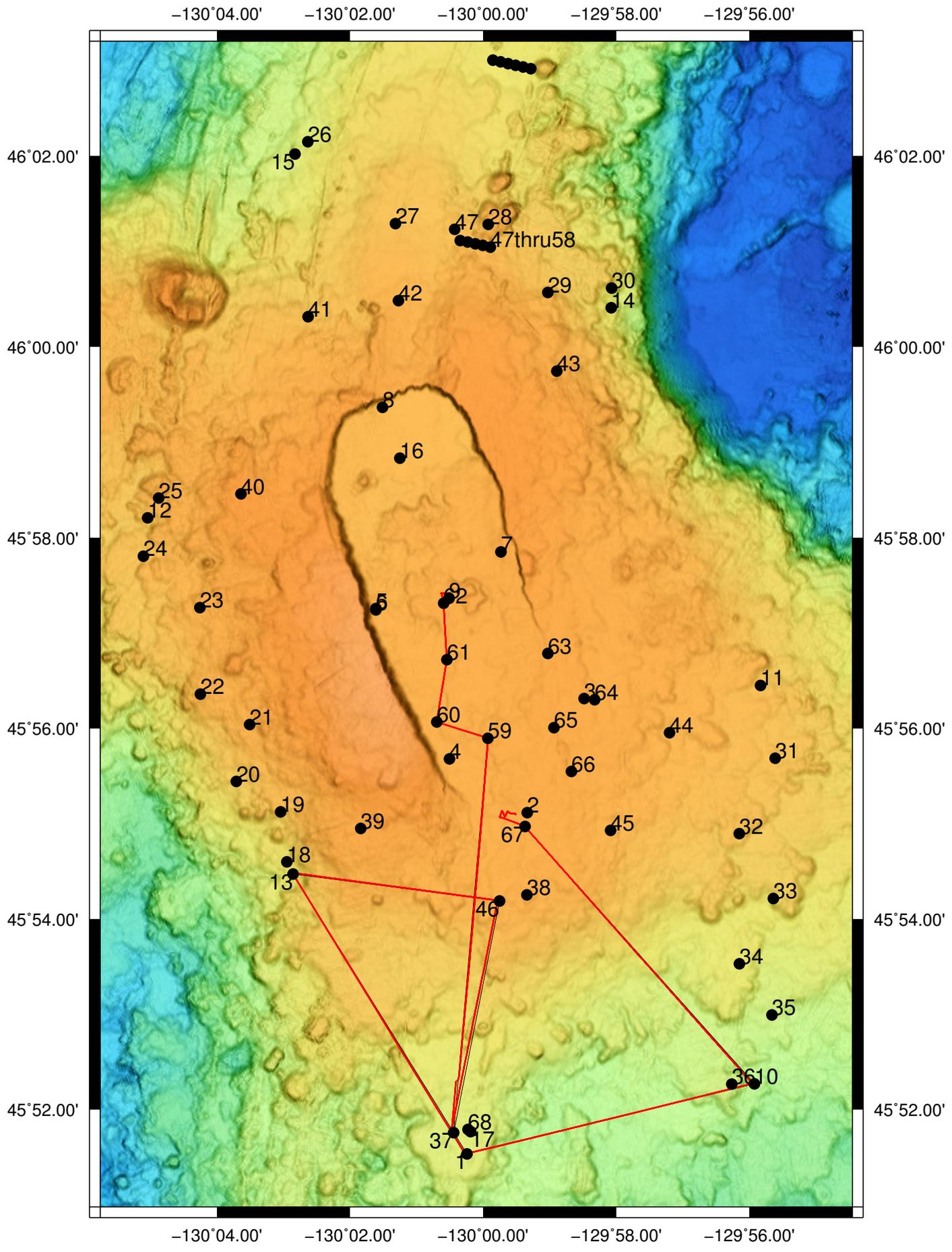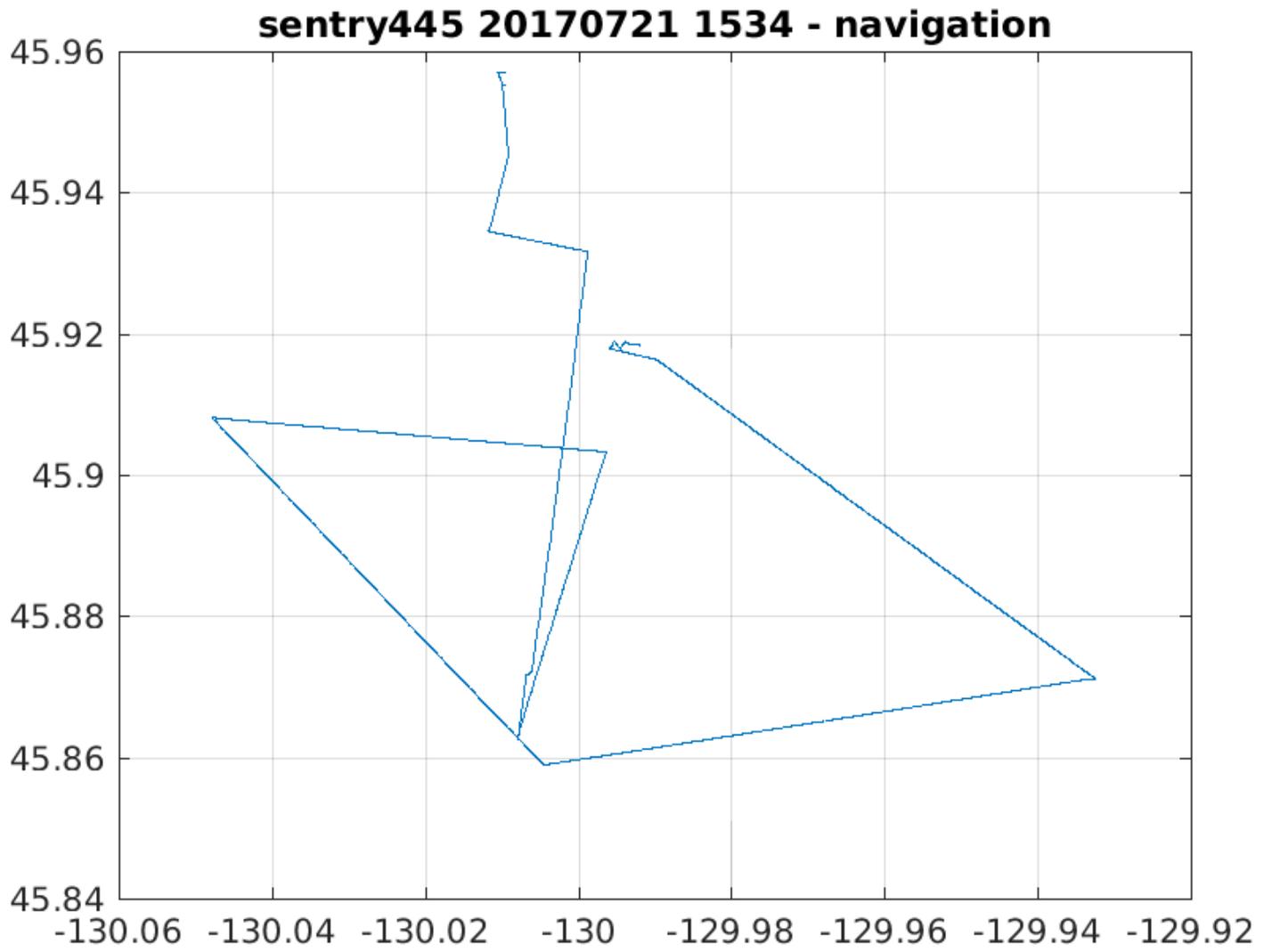
Figure 31: Latitude/Longitude plot of Sentry dive 445 based on post-processed navigation.
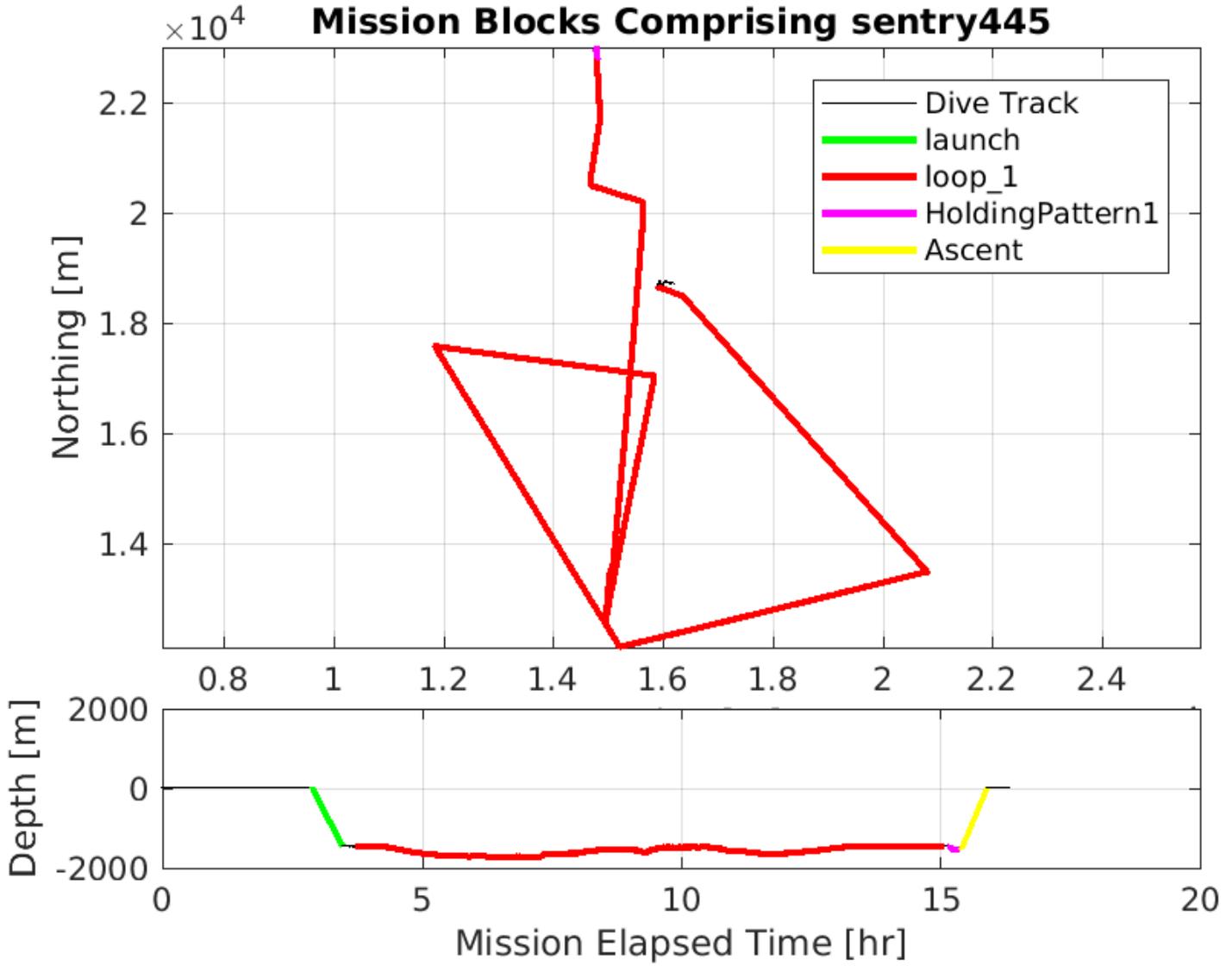
Figure 32: Mission Survey Blocks of Sentry dive 445
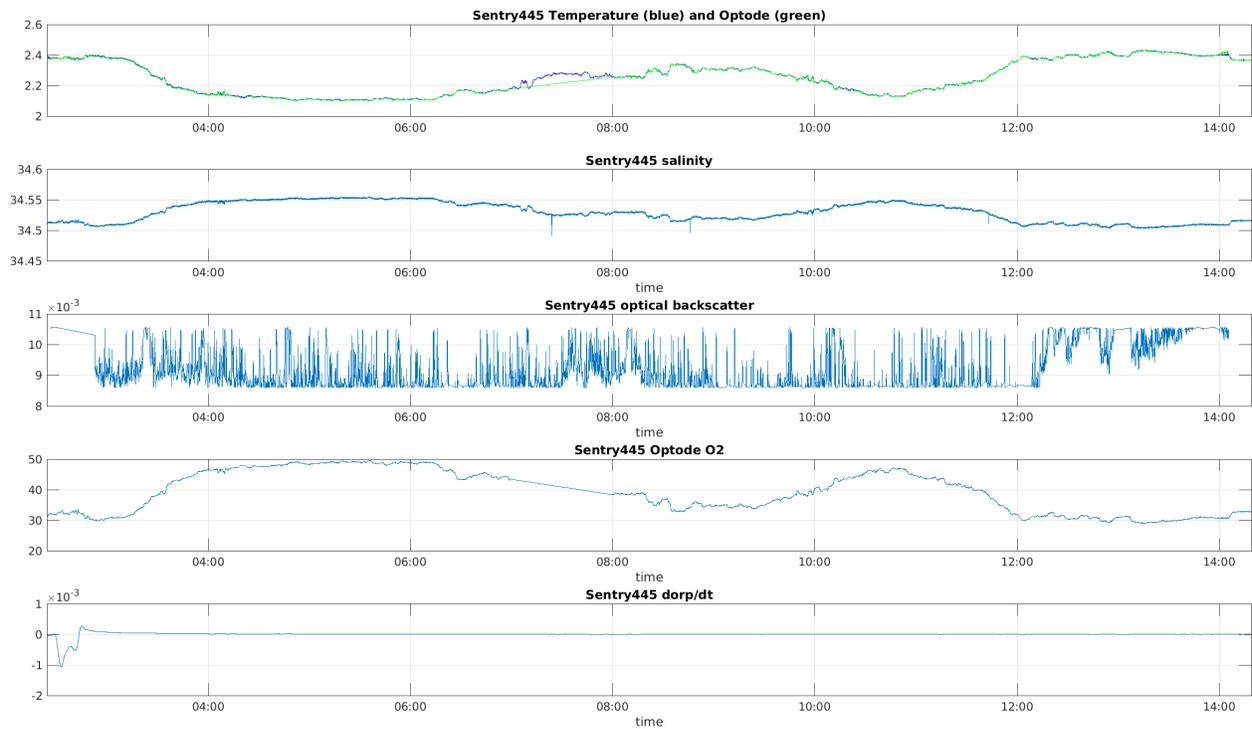
Figure 33: Time series plot of five of the basic sensors on Sentry, from top to bottom, temperature, salinity, optical backscatter, dissolved Oxygen, and ORP.
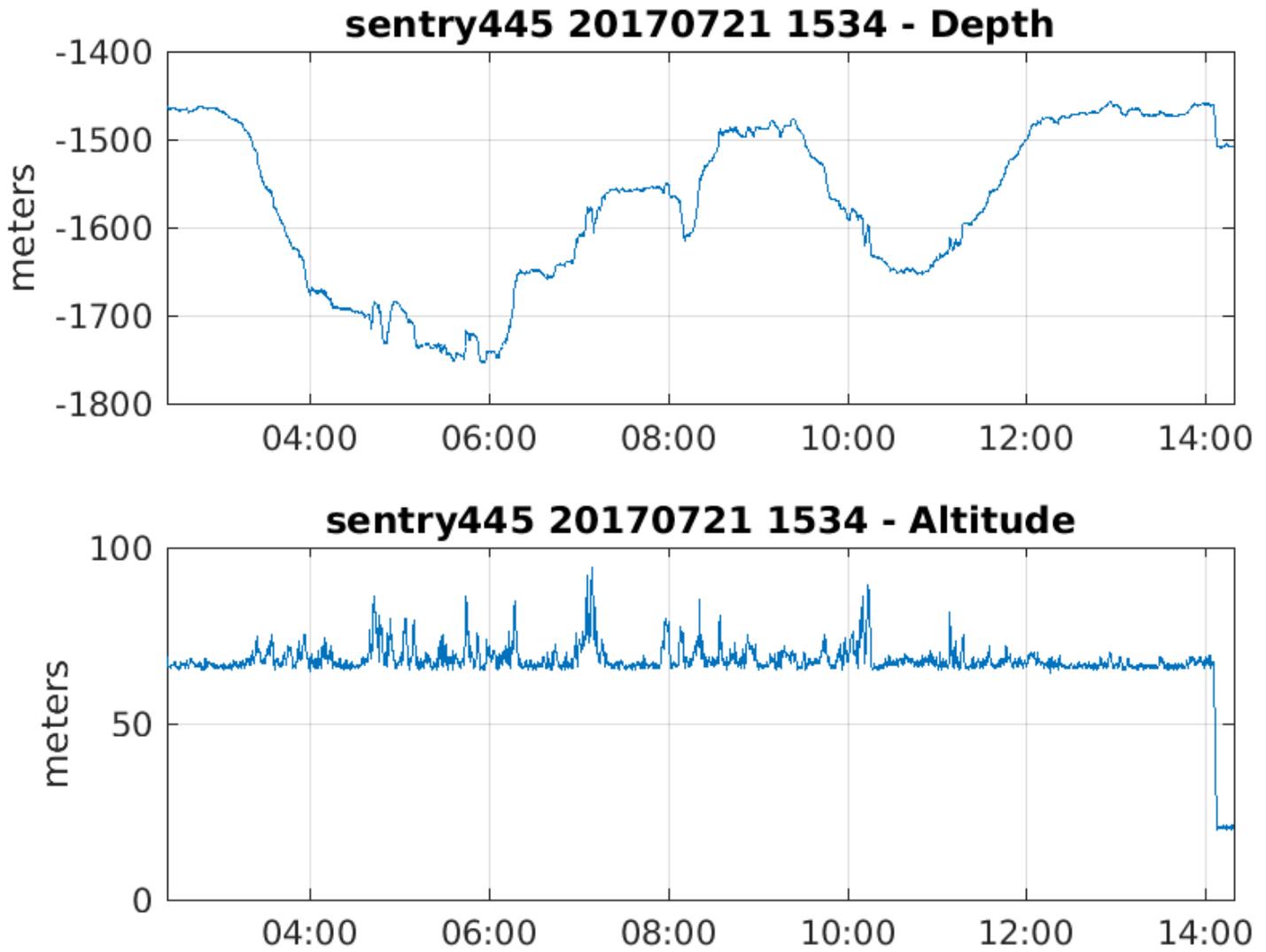
Figure 34: Depth and Altitude of Sentry during dive 445.
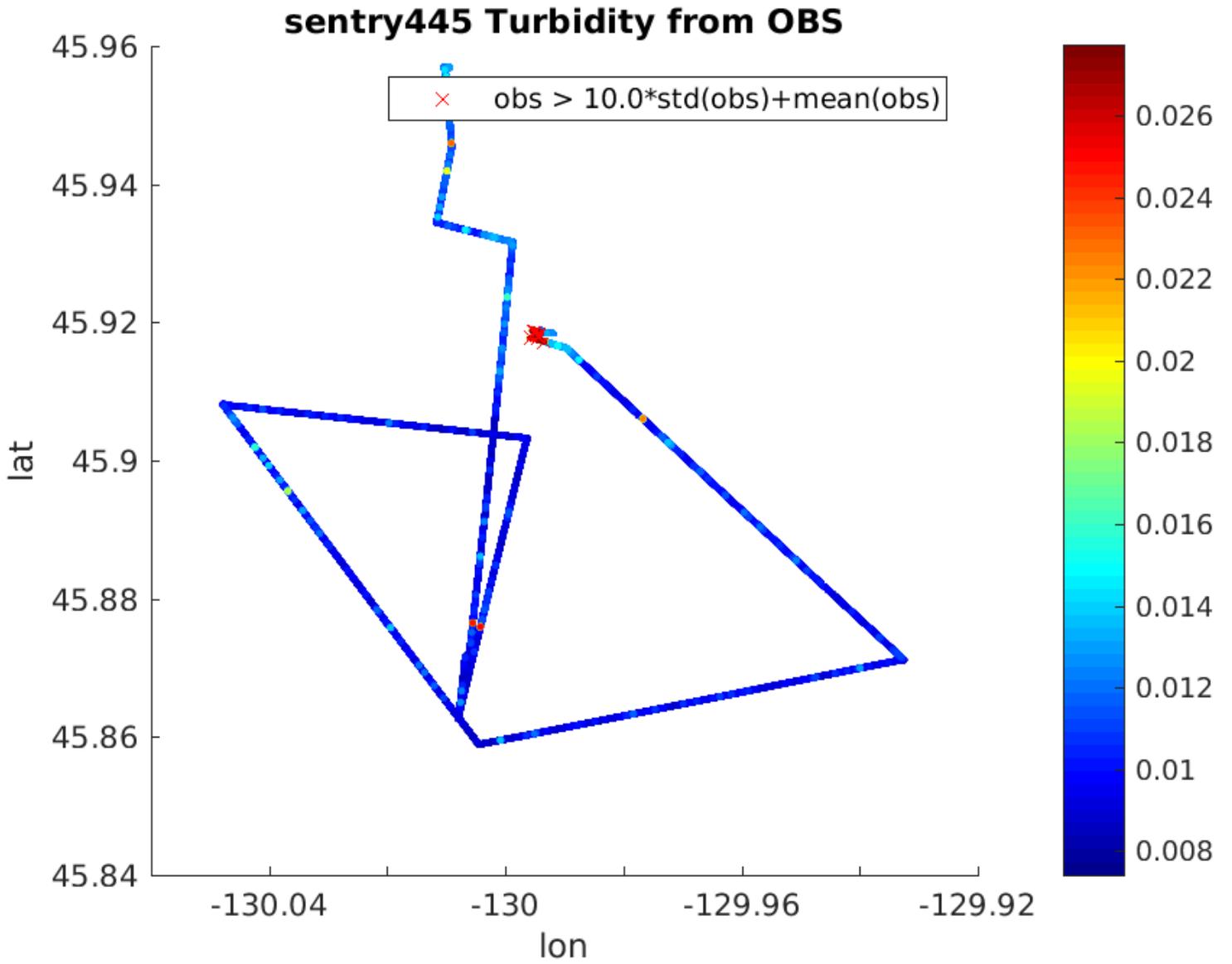
Figure 35: Optical backscatter on dive 445.
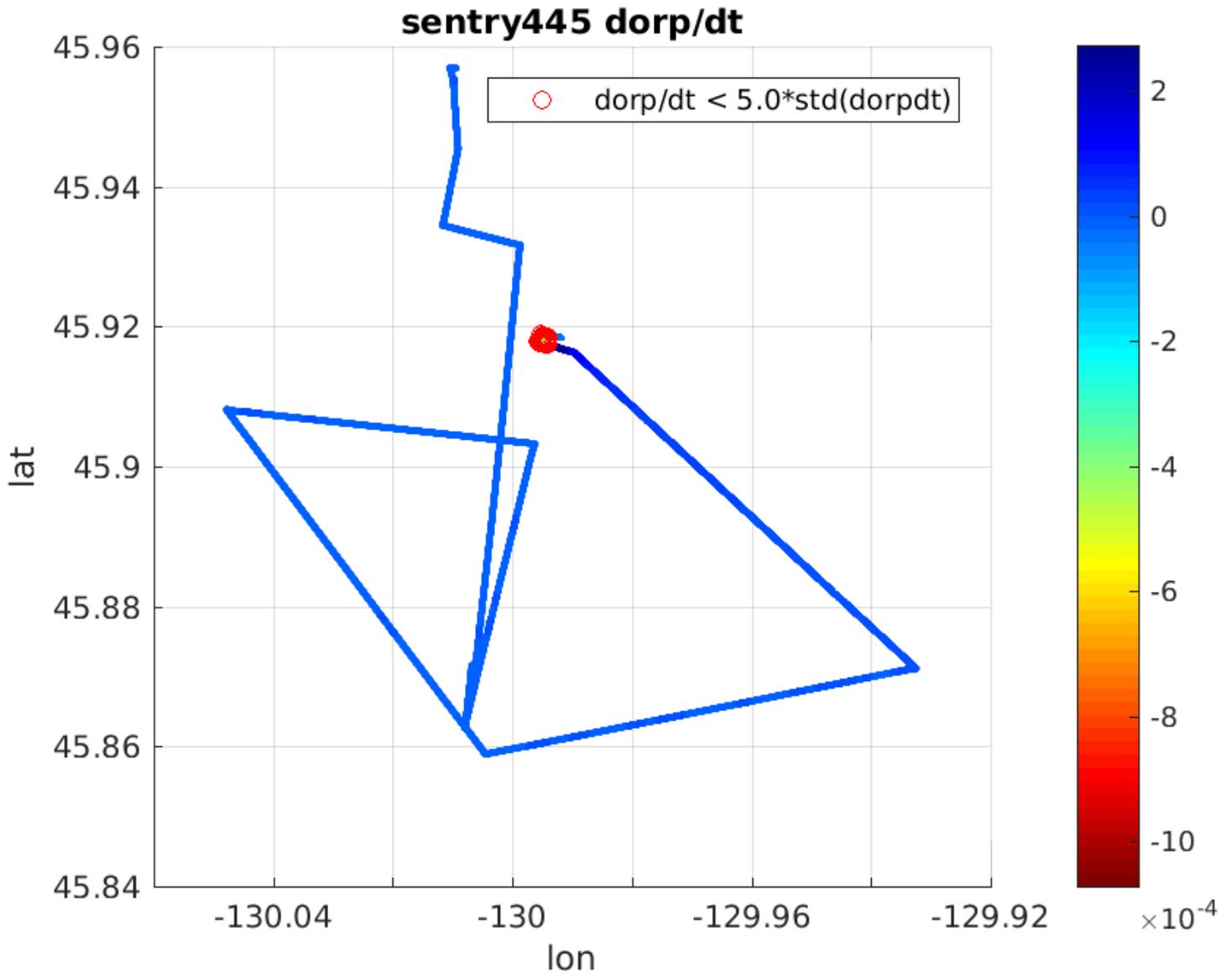
Figure 36: ORP sensor data during dive 445.
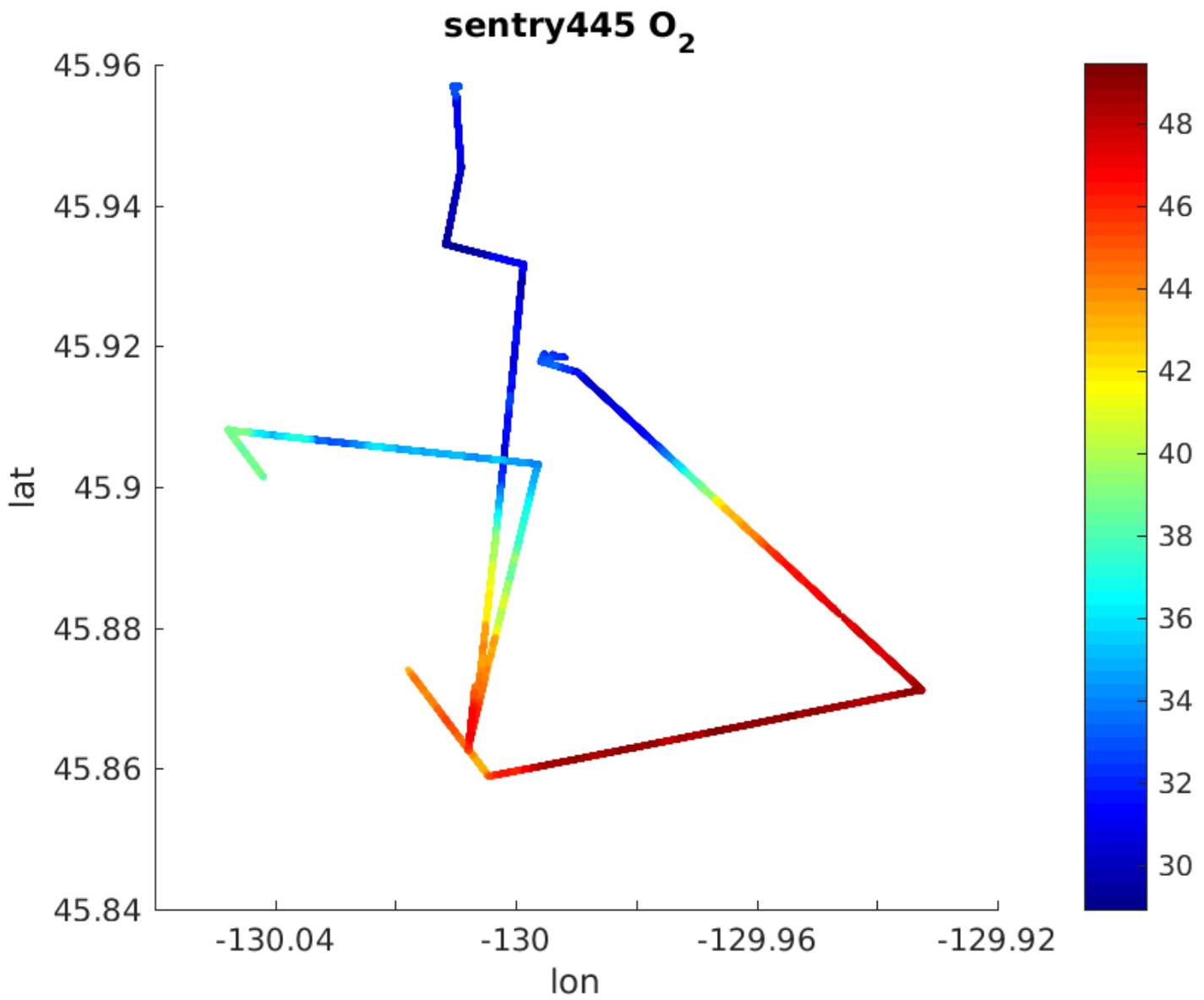
Figure 37: O2 sensor data during dive 445.

Figure 38: Temperature sensor data during dive 445.
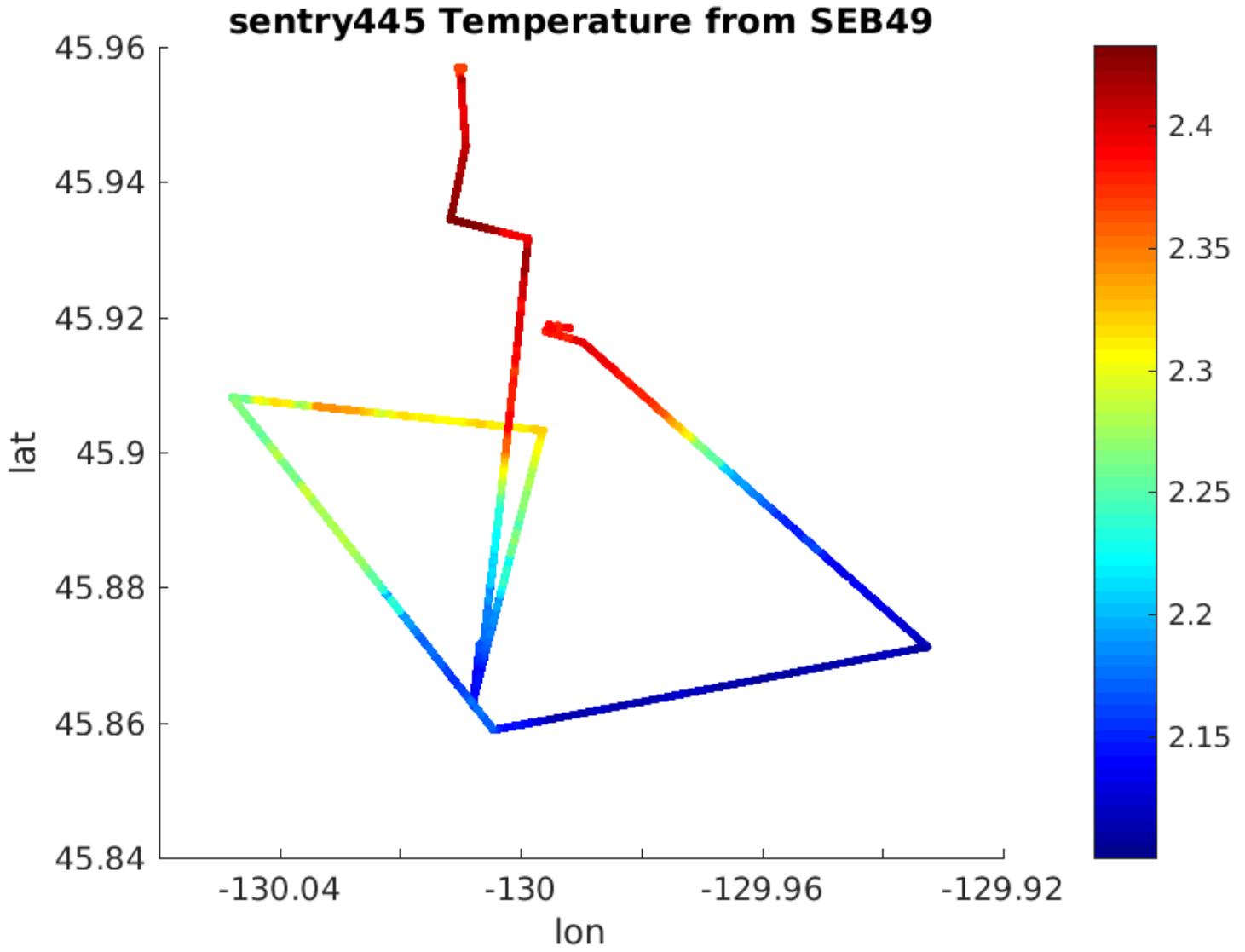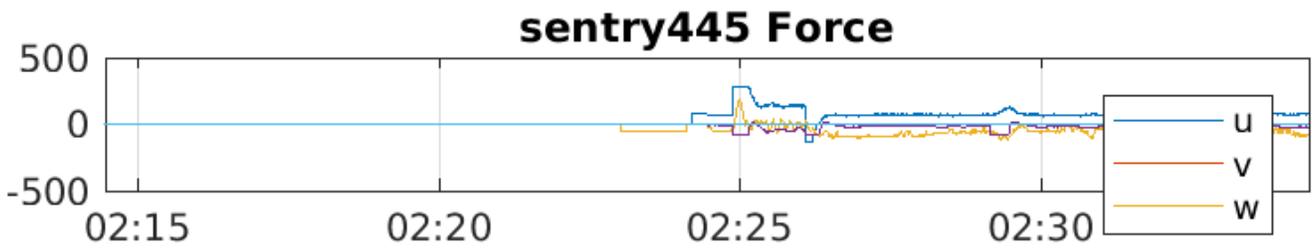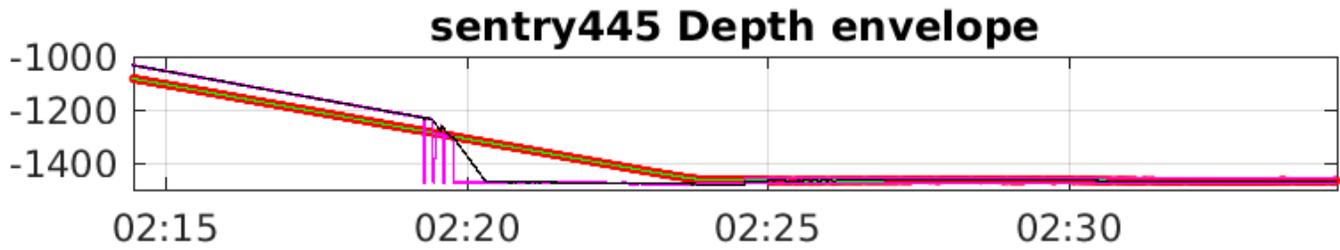
Figure 39: Bottom Approach for during dive 445.
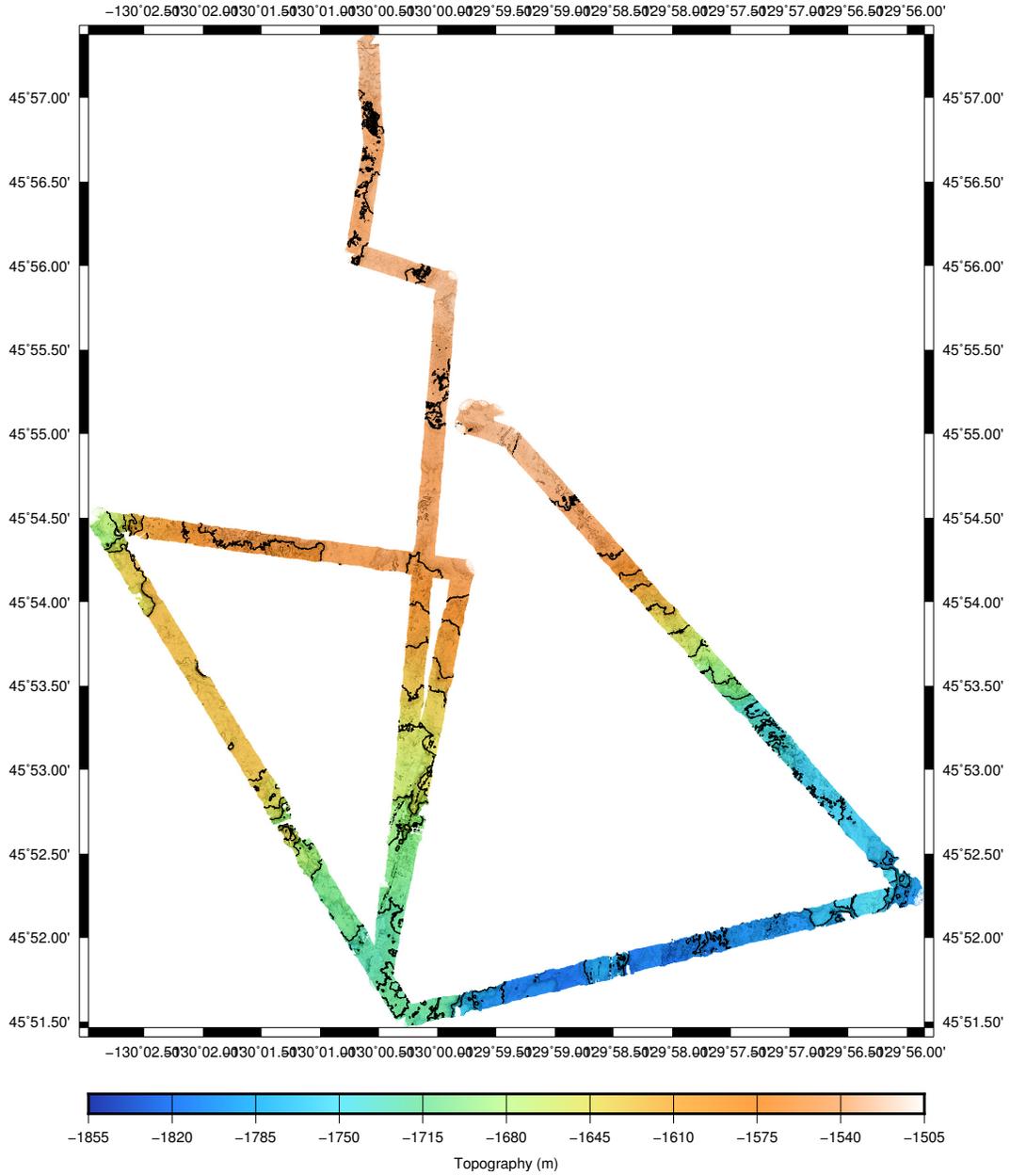
Figure 40: Processed multibeam data from dive 445

# Sentry 446 Dive Report
# DRAFT

**WHOI Sentry Operations Group**
Sean Kelley, Justin Fujii, Zac Berkowitz, Danik Forsman, Theo Guerin

Sentry Expedition Leader: Sean Kelley

Chief Scientist/PI: Scott Nooner, UNCW
Chief Scientist/PI: Bill Chadwick, OSU-HMSC

# Summary

**Weather:** winds were 20 knots with 5 to 7 foot seas for launch. 18 knot winds with 4 to 5 foot swell for recovery.

**Reason for end of dive:** Mission complete.

# Vehicle Configuration

The science sensing suite for this dive was:

Table 6: Sentry Sensor Configuration

| Sensor |
| --- |
| APS 1540 Magnetometers (3) |
| Reson 7125 Multibeam Sonar |
| Seabird SBE49 CTD |
| Seapoint OBS |
| Anderaa optode model 4330 |
| 300kHz RDI DVL |
| Digital Still Camera |
| Blue View P900-90 Forward Looking Sonar |
| IXEA PHINS |
| Reson Sound Velocity Probe |
| NOAA PMEL MAPR |
| NOAA PMEL ORP Sensor |

# Important Positions

**Dive Origin:** 45 45.0000 -130 -12.0000

**Launch Position:** sentry446 launch position: 46 2.147'N 130 0.589'W

# Narrative

Sentry446 was the fifth and final dive of the cruise at axial caldera. This dive was aimed at capturing additional high resolution multibeam north and east of the caldera adding to existing high resolution multibeam. Sentry446 included two major surveys, both 6 six hours in duration with a break between the two surveys allowing Sentry to drive south and check in with the ship. There were no issues during the dive with a smooth recovery ending Sentry operations for the cruise.

## Issues

None

## Chief Scientist Comments

None

## Dive Statistics

### 0.9   sentry446 Summary

sentry446 Summary
Origin: 45.750000 -130.200000
Origin: 45 45.000'N 130 12.000'W
Launch: 2017/07/22 04:31:55
Survey start: 2017/07/22 05:09:39
Survey start: Lat:46.037144 Lon:-130.009594
Survey start: Lat:46 2.229'N Lon:130 0.576'W
Survey end: 2017/07/22 19:38:35
Survey end: Lat:46.004659 Lon:-130.000612
Survey end: Lat:46 0.280'N Lon:130 0.037'W
Ascent begins: 2017/07/22 19:38:35
On the surface: 2017/07/22 20:05:04
On deck: 2017/07/22 20:26:02
descent rate: 41.6 m/min
ascent rate: 54.2 m/min
survey time: 14.5 hours
deck-to-deck time 15.9 hours
Mean survey depth: 1538m
Mean survey height: 65m
distance travelled: 50.55km
average speed; 0.97m/s
average speed during photo runs: NaN m/s over 0.00 km
average speed during multibeam runs: 0.98 m/s over 50.55 km
total vertical during survey: 4747m
Battery energy at launch: 18.2 kwhr
Battery energy at survey end: 6.7 kwhr
Battery energy on deck: 6.6 kwhr

## Sensor Information

This is a recently added section with selected sensor metadata. This section will be expanded in coming months. Additional data is available in the sentryxxx/nav-sci/proc directory within the sentryxxx_config

matlab structure as well as in ascii text logs in sentryxxx/metadata. At present metadata is not yet automatically collected on all sensors.

## 0.10 sentry446 Devices

| Instrument | Model | Serial Num. | Comments | Config File |
|---|---|---|---|---|
| USBL | Sonardyne AvTrak2 | | | `avtrak_20170722_0242.cfg` |
| DVL | RDI Navigator (300kHz) | 727-2000-00M | CX: 1, WP: 0 | `dvl300_20170722_0243.cfg` |
| SAIL | obs A/D | 13 | A: 5, G: 1.00, O: 0 | `a2d2-pods_20170722_0243.cfg` |
| | orp A/D | 9 | A: 3, G: 1.00, O: 0.002 | |

# Plots and Images

This section contains selected images of data products and plots of vehicle navigation and selected sensors.

Sentry446 dive tracks

Figure 41: Latitude/Longitude plot of Sentry dive 446 based on post-processed navigation.
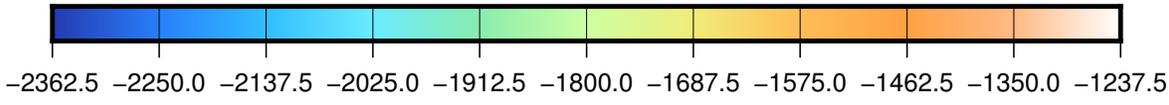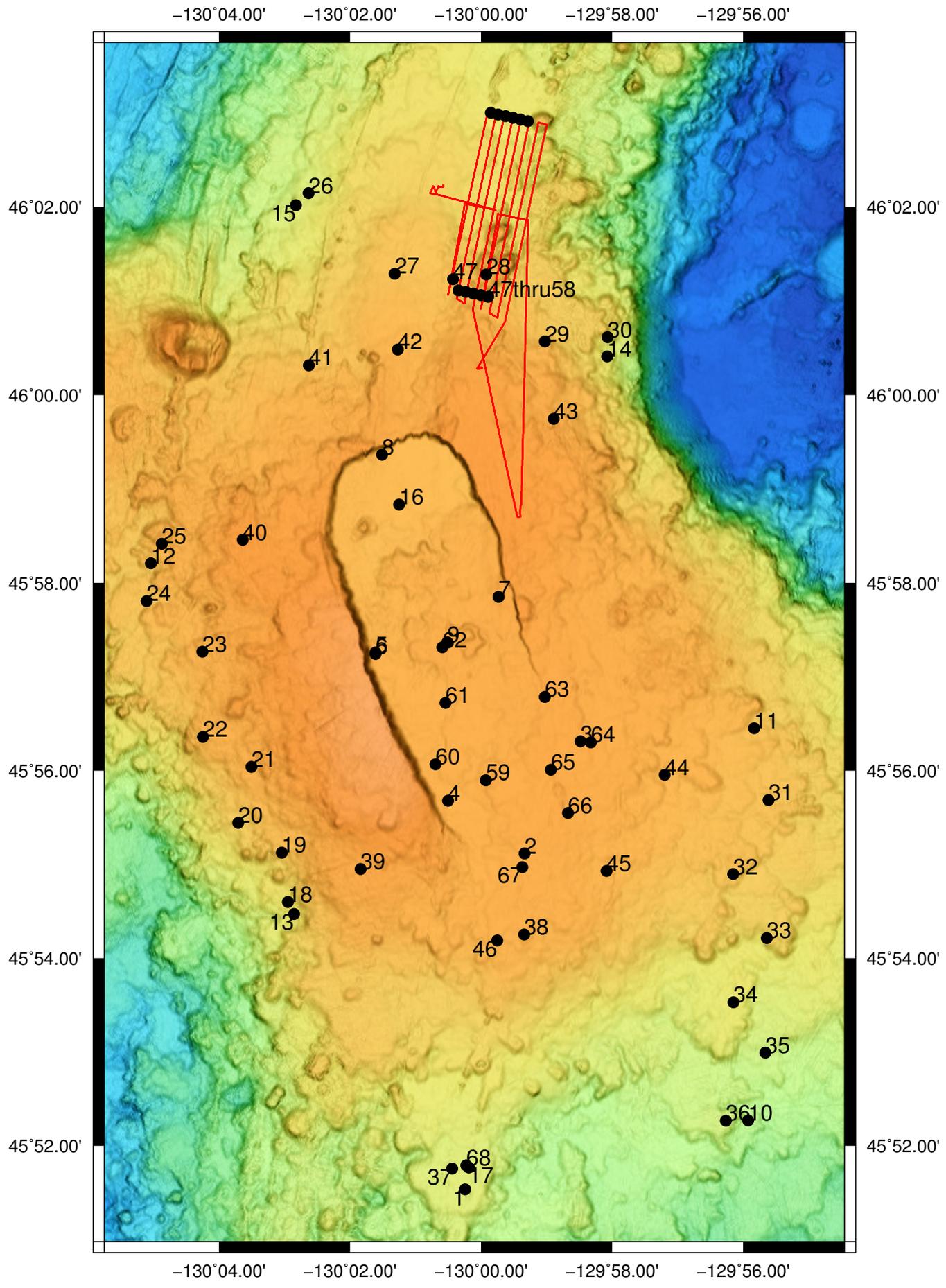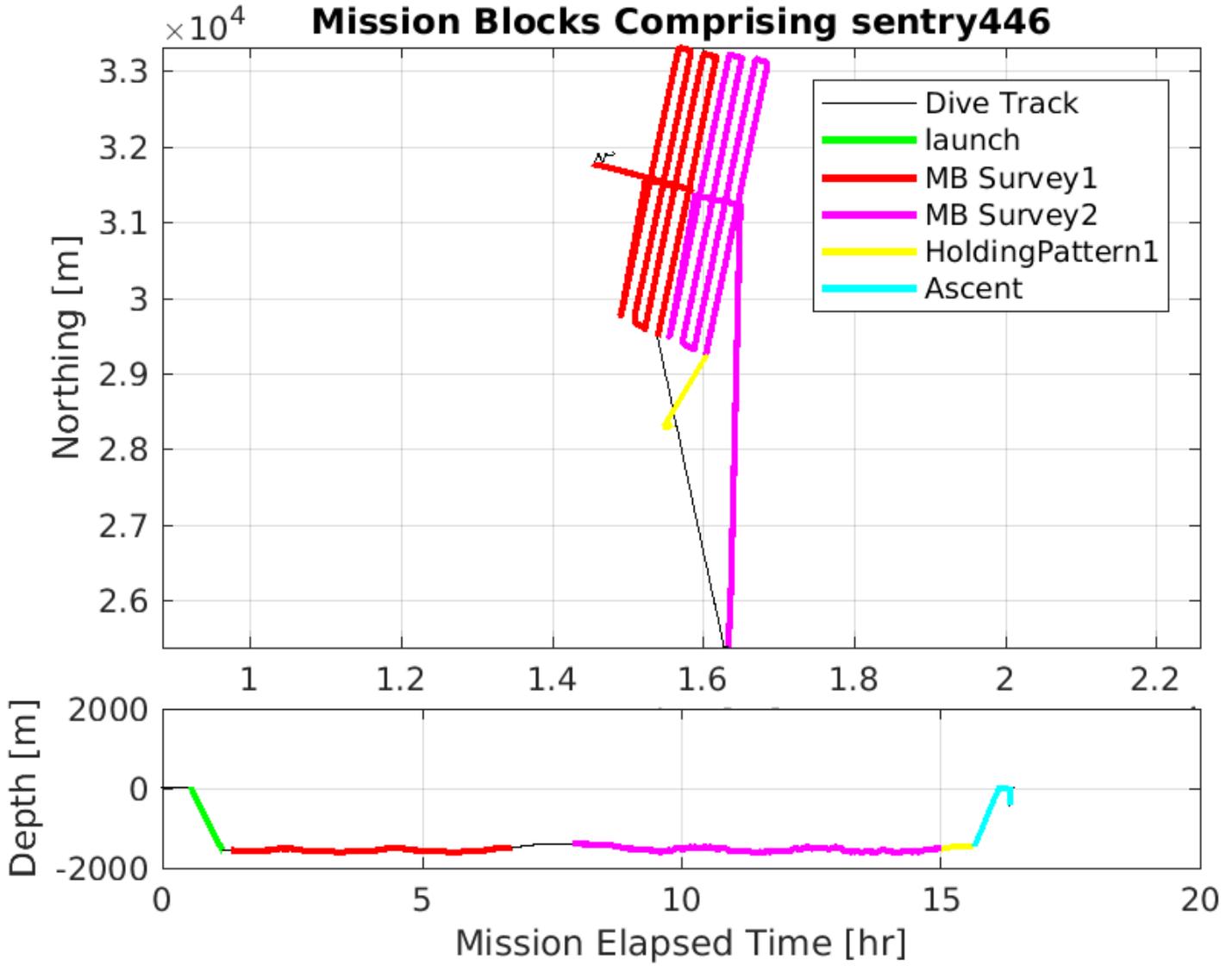
Figure 42: Mission Survey Blocks of Sentry dive 446
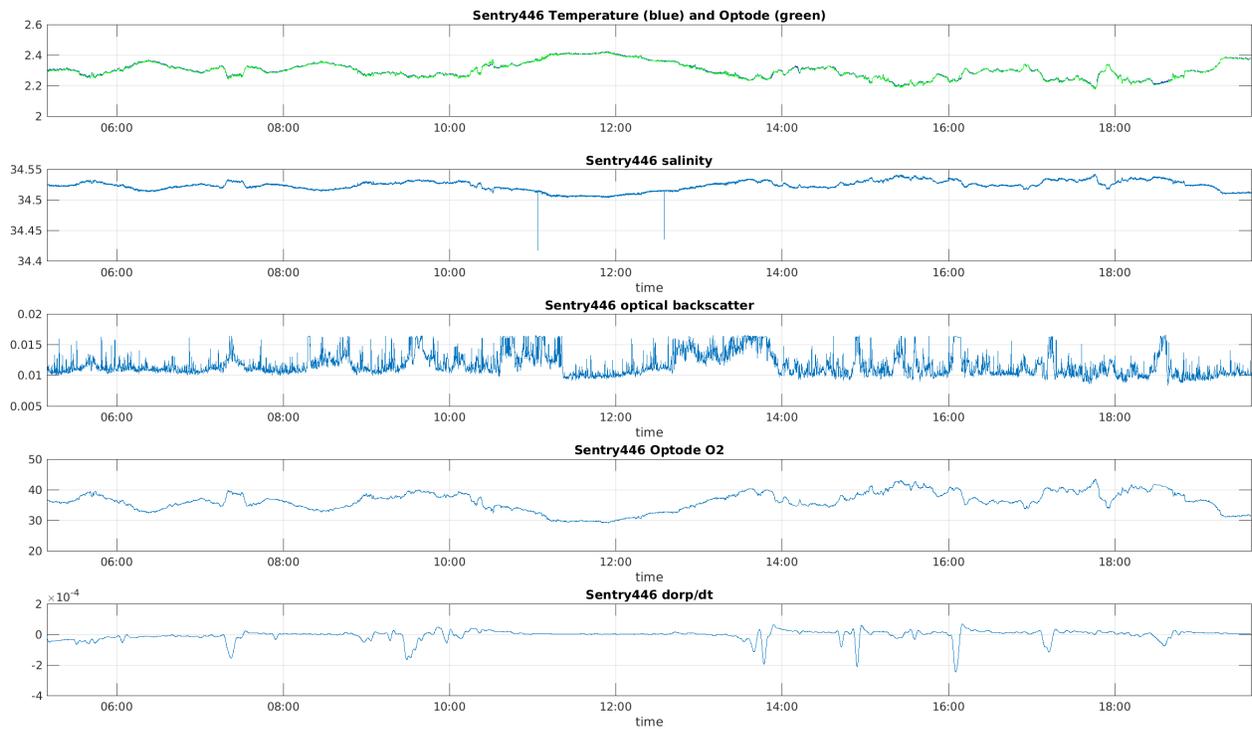
Figure 43: Time series plot of five of the basic sensors on Sentry, from top to bottom, temperature, salinity, optical backscatter, dissolved Oxygen, and ORP.

9
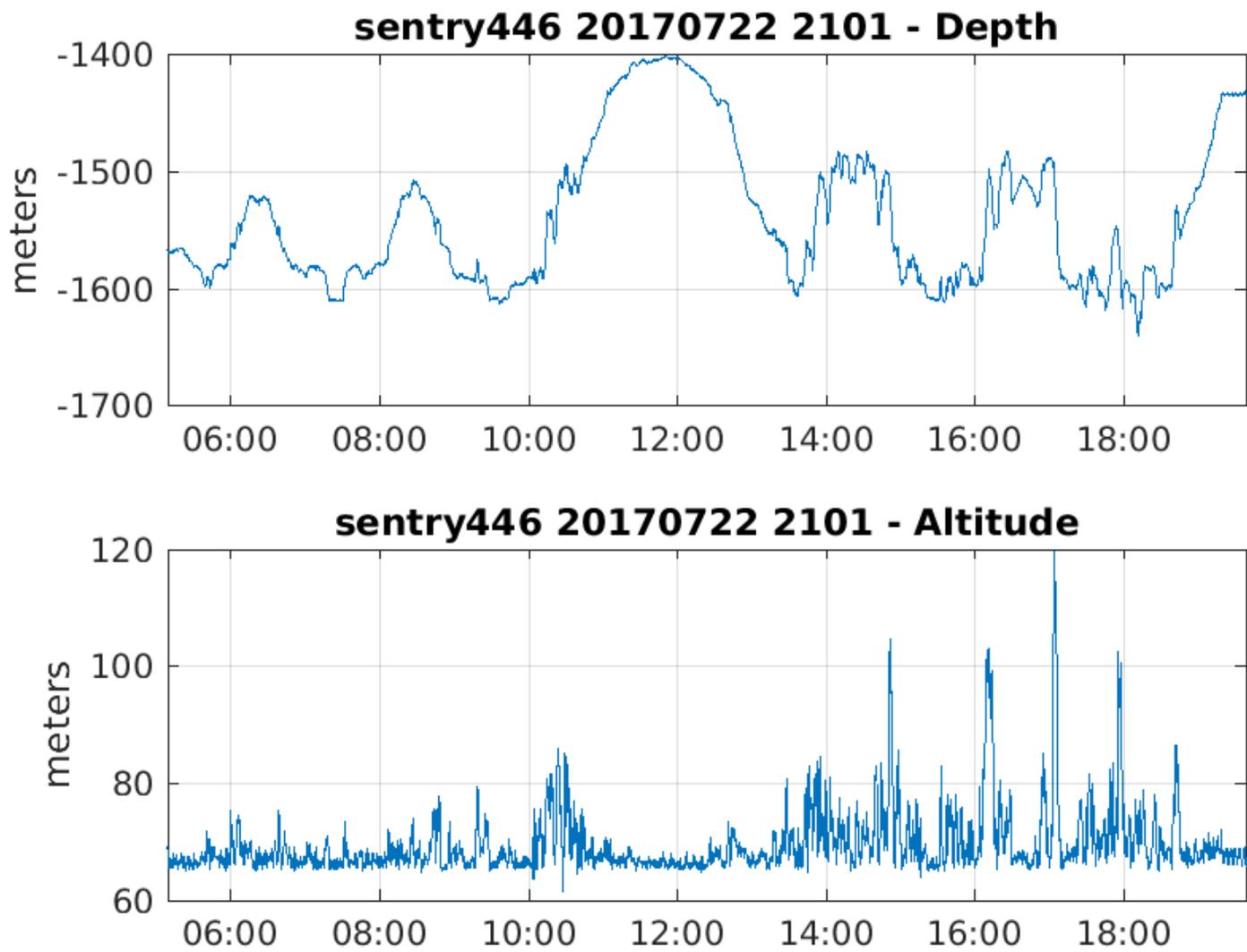
Figure 44: Depth and Altitude of Sentry during dive 446.
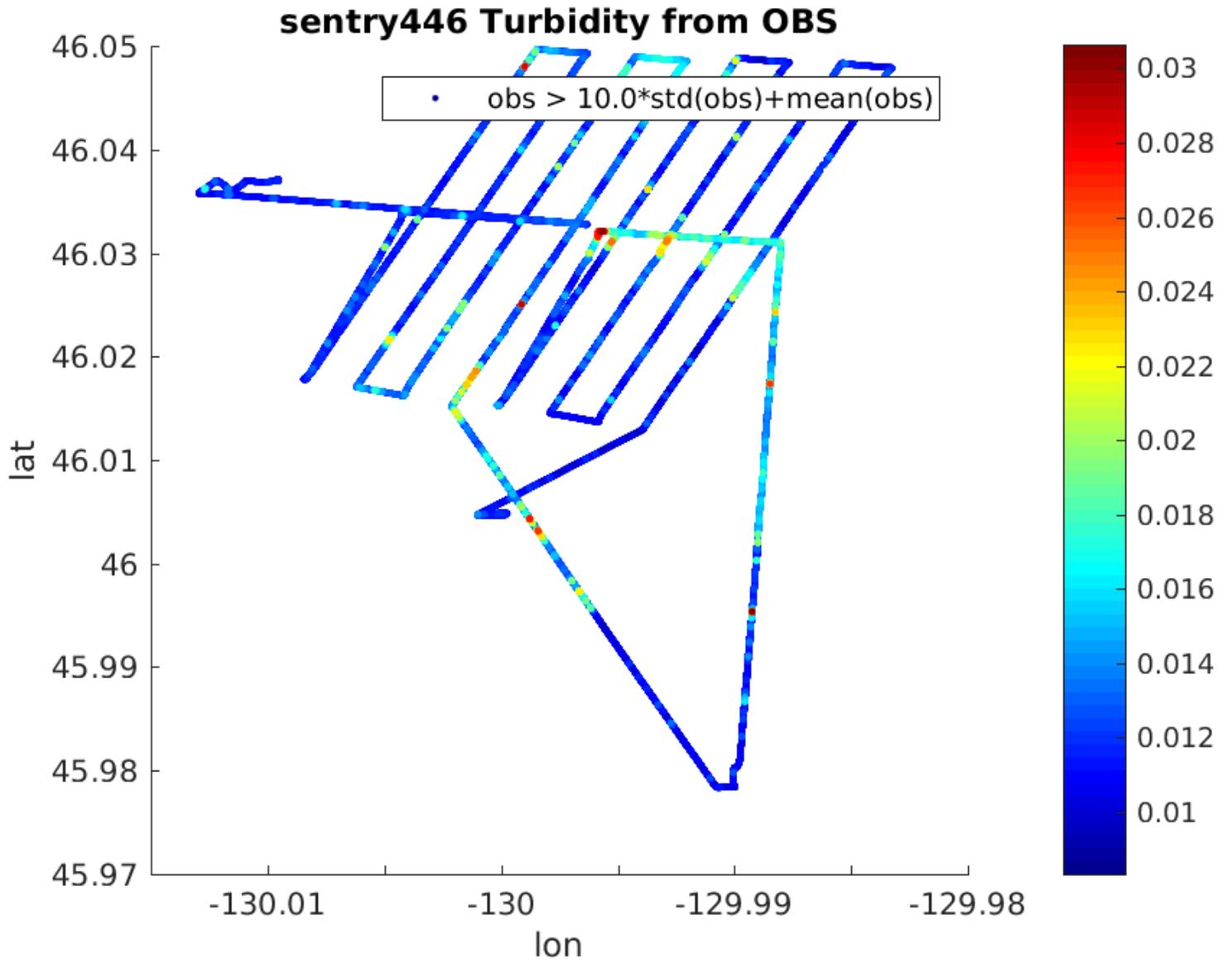
Figure 45: Optical backscatter on dive 446.
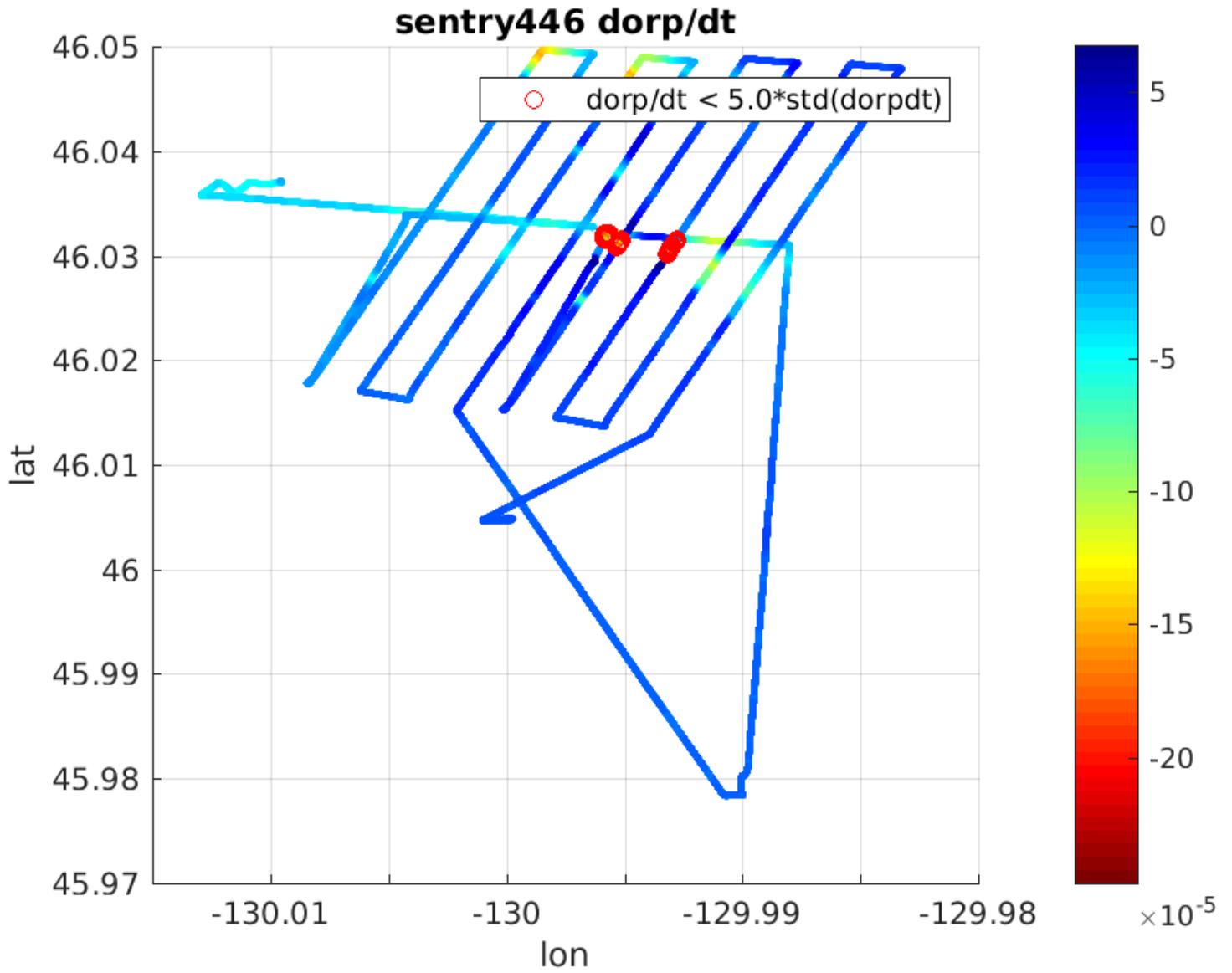
Figure 46: ORP sensor data during dive 446.
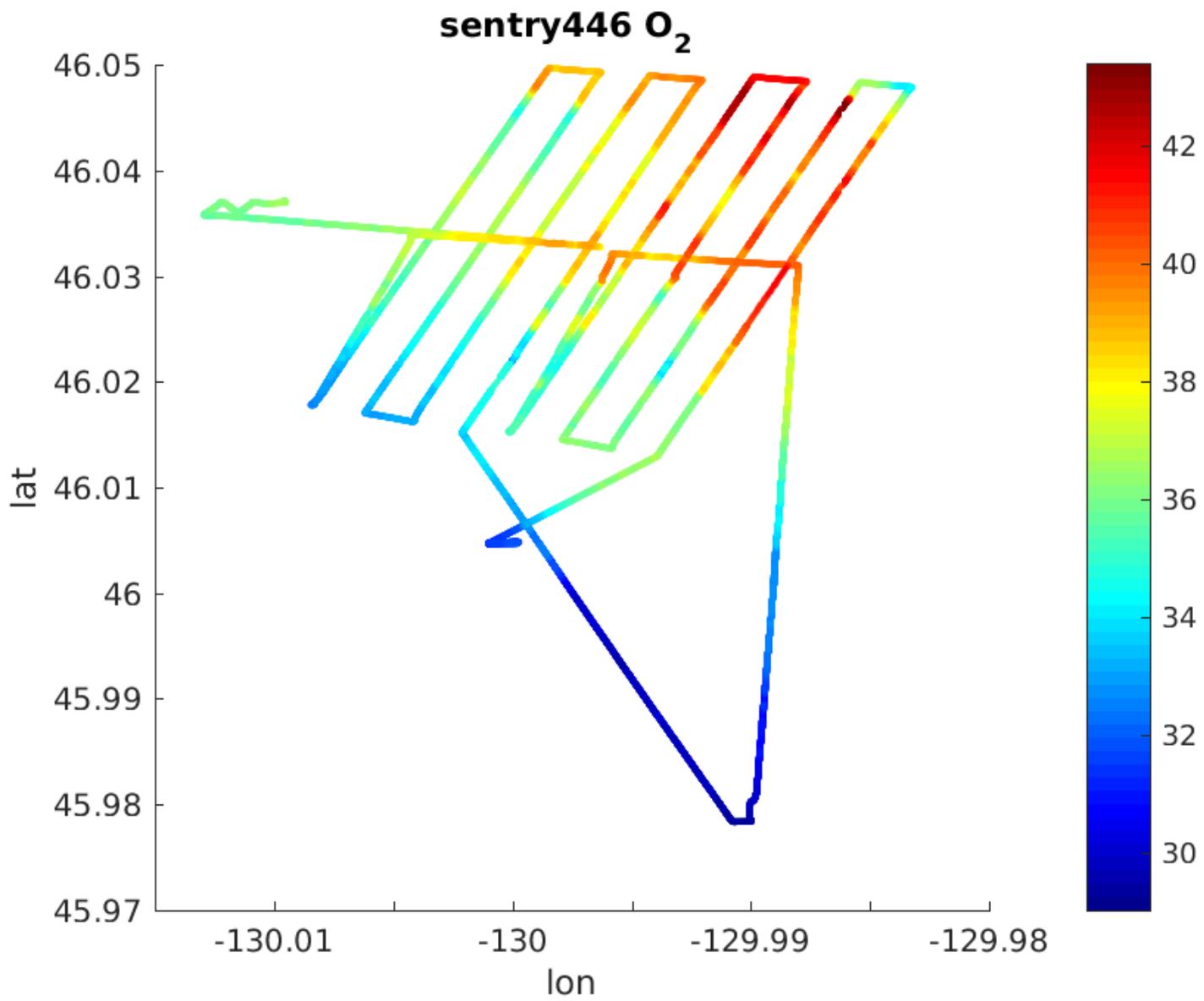
Figure 47: O2 sensor data during dive 446.
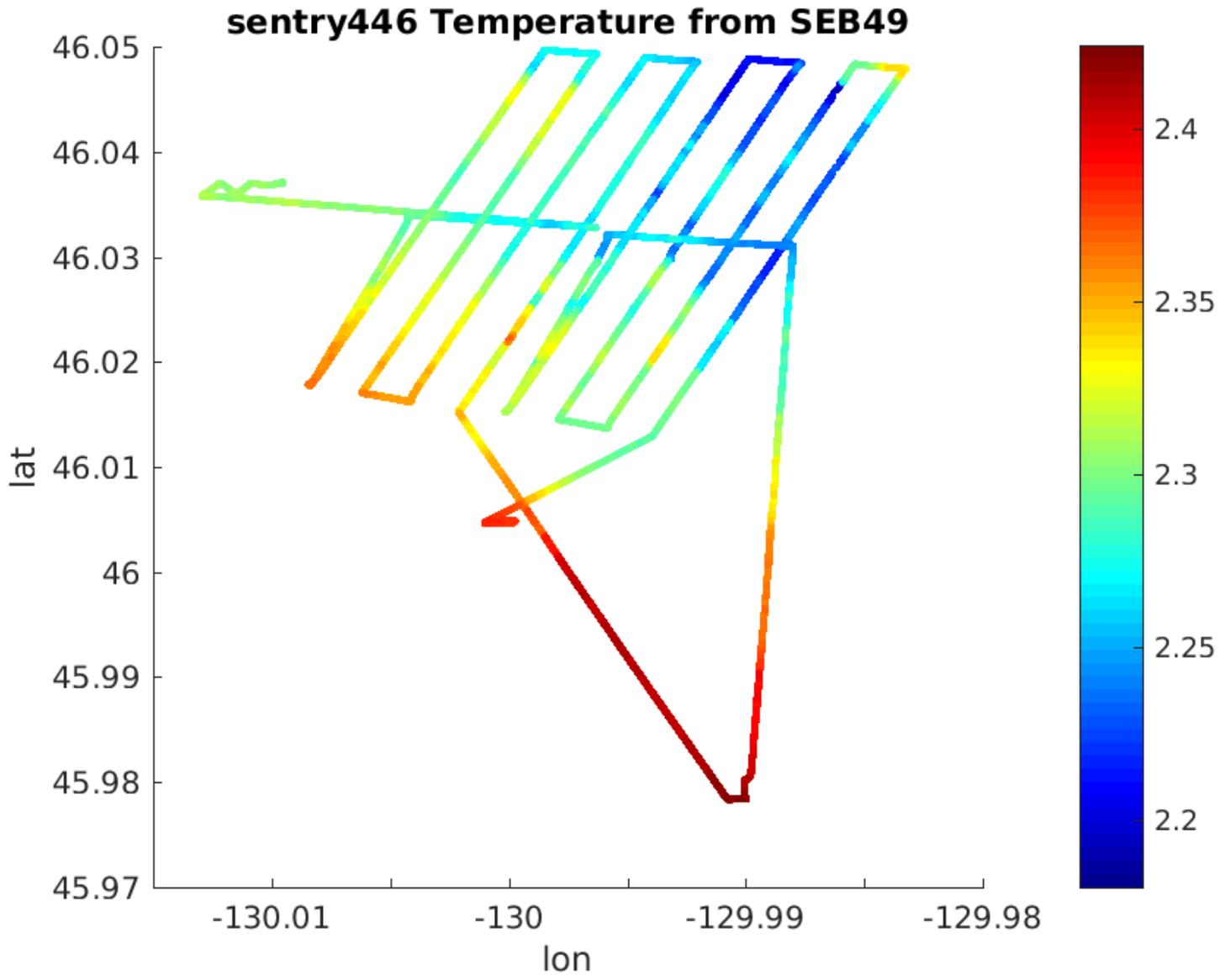
Figure 48: Temperature sensor data during dive 446.
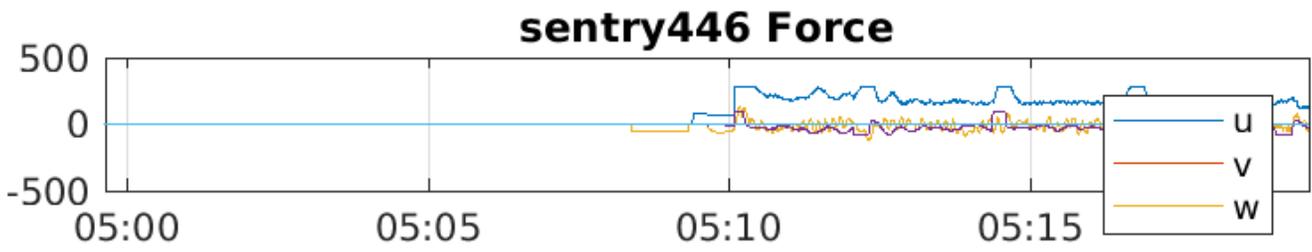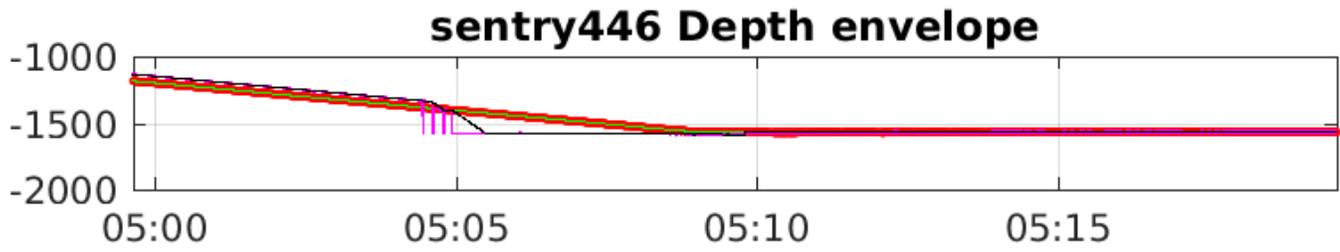
Figure 49: Bottom Approach for during dive 446.

sentry446_20170722_2101_rnv V01 Bathy Generated at 20170722_2114

# CASIUS Calibration Report

**Sonardyne** SOUND IN DEPTH
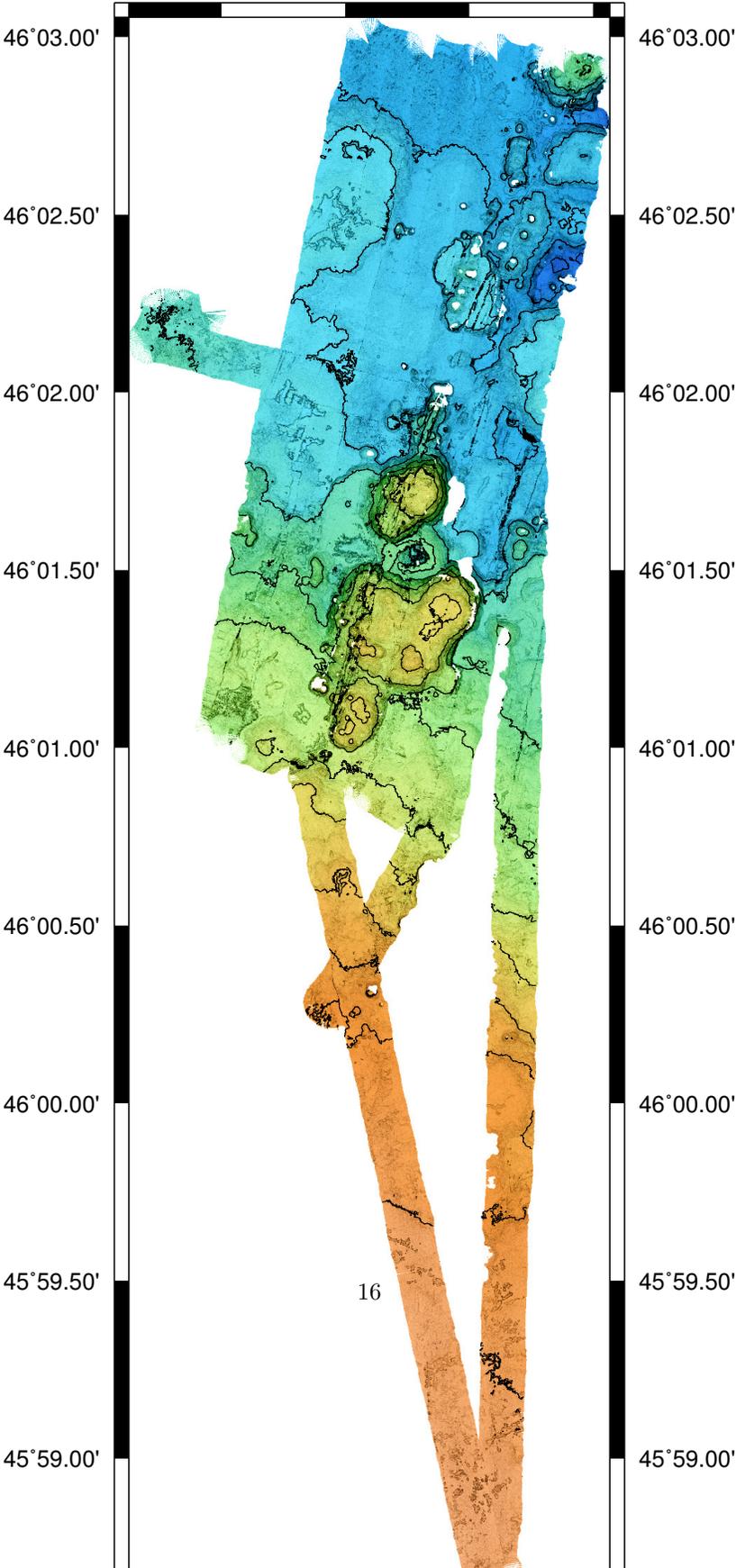
**Vessel:** Ship 1          **Device No:**          **Date/Time:** 15 July 2017 09:32:49

Tcvr=Transceiver 1; Beacon=ELV 901; GPS=GNSS 1; Heading=PitchRoll 1 [Corrections(P:0,R:0,H:0)];
Attitude=PitchRoll 1 [Corrections(P:0,R:0,H:0)]

## Settings:

| Initial Estimates for BoxIn | |
|---|---|
| Transceiver depth offset | 5.666m |
| Transceiver depth | 5.666m |
| Antenna starboard offset | -2.567m |
| Antenna forward offset | -20.638m |
| Antenna height offset | 8.868m |

| Transceiver & Beacon | |
|---|---|
| Transceiver Index | 11 |
| Beacon Name | ELV 901 |
| Turn Around Time | 320.0ms |

| Error Estimates for BoxIn | |
|---|---|
| DGPS lags USBL | 0.00s |
| Range measurement | 0.2m |
| Range gate | 1.0m |
| DGPS position | 2.0m |
| Beacon position | 30.0m |
| Beacon depth | 5.0m |
| Sound velocity | 15.0m/s |
| Transceiver depth | 0.5m |
| Transceiver offset | 1.0m |

| Depth Aiding | |
|---|---|
| Boresight Angle Limit | 22.0º |
| Depth Difference Limit | 1.0m |

| Transceiver Attitude Calculation Inputs | |
|---|---|
| Angle Gate | 2.0º |
| Known Heading Correction | n/a |

| Values Used During Data Collection | |
|---|---|
| Transceiver Pitch Correction | 0.00º |
| Transceiver Roll Correction | 0.00º |
| Transceiver Heading Correction | 0.00º |
| Sound Velocity | 1477.9m/s |

## Results:

| Beacon BoxIn | Beacon Eastings | Beacon Northings | Beacon Depth | Sound Velocity | Transceiver Starboard Offset | Transceiver Forward Offset |
|---|---|---|---|---|---|---|
| Before | 422985.33m | 5086130.75m | 1485.33m | 1477.94m/s | 0.05m | -15.40m |
| Calculated | 423097.59m | 5086079.11m | 1514.65m | 1473.25m/s | 0.35m | -16.24m |
| Calculated Accuracy | 0.05m | 0.05m | 0.22m | 0.12m/s | 0.04m | 0.04m |

| Transceiver Attitude | Pitch Correction | Roll Correction | Heading Correction |
|---|---|---|---|
| Before | 0.00º | 0.00º | 0.00º |
| Calculated | **-0.37º** | **2.41º** | **-5.25º** |
| Calculated Accuracy | 0.00º | 0.00º | 0.01º |

## Statistics:

| | Before CASIUS (distance) | After CASIUS (distance) | Before CASIUS (% depth) | After CASIUS (% depth) |
|---|---|---|---|---|
| 39.4% Beacon Positions (1 sigma) | 69.1m | 3.4m | 4.56 | 0.22 |
| 50.0% Beacon Positions (CEP) | 85.6m | 4.3m | 5.65 | 0.28 |
| 63.2% Beacon Positions (1 Drms) | 108.2m | 5.9m | 7.14 | 0.39 |
| 86.5% Beacon Positions (2 sigma) | 130.3m | 11.8m | 8.60 | 0.78 |
| 98.2% Beacon Positions (2 Drms) | 144.1m | 27.4m | 9.51 | 1.81 |

## General:

| | Beacon BoxIn | Transceiver Attitude |
|---|---|---|
| Number of Iterations | 5 | 9 |
| Number of Fixes Used | 1996 | 1991 |
| Number Depth Aided | | 1279 |
| Average weighted residuals | 0.038 | 0.196 |

## Vessel Track
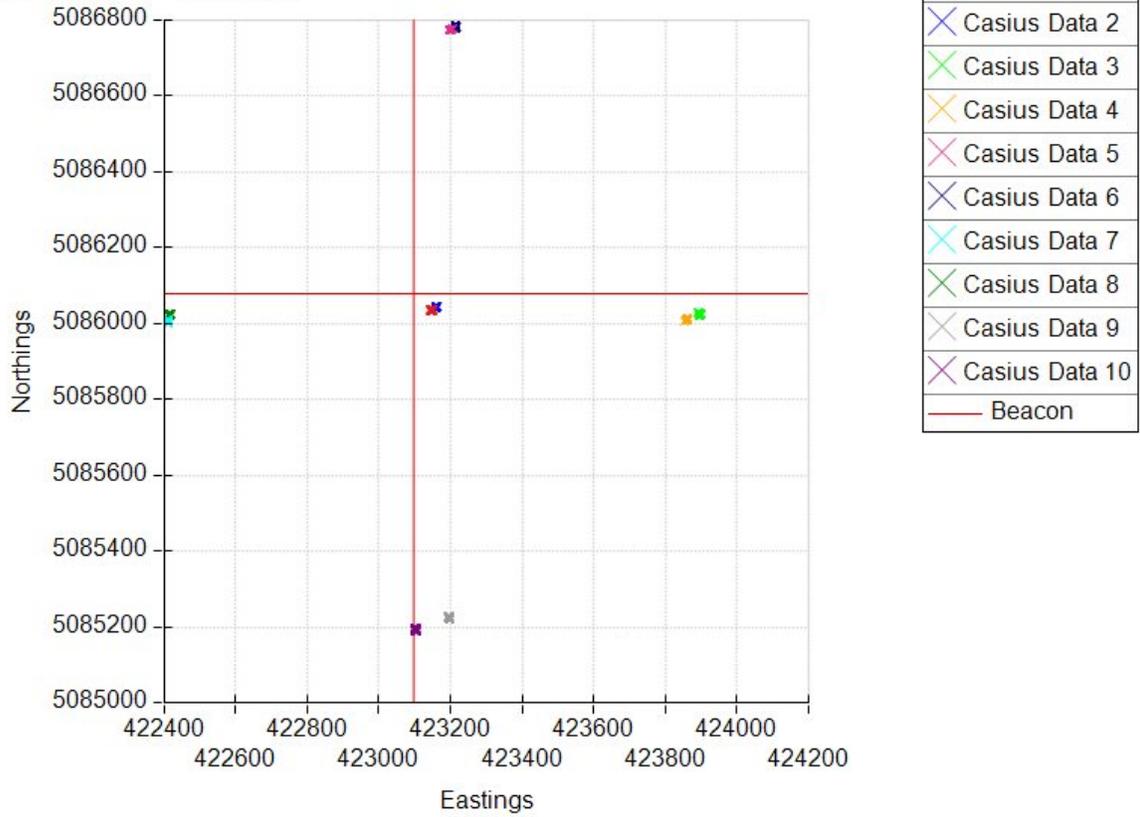


**Data used:**

| Name | Filename | Start | End | #Acoustic | #Position |
|------|----------|-------|-----|-----------|-----------|
| Casius Data 1 | n/a | 15/07/2017 09:32:49 | 15/07/2017 09:49:30 | 204 | 1001 |
| Casius Data 2 | n/a | 15/07/2017 09:59:55 | 15/07/2017 10:09:49 | 200 | 594 |
| Casius Data 3 | n/a | 15/07/2017 10:29:36 | 15/07/2017 10:39:44 | 200 | 608 |
| Casius Data 4 | n/a | 15/07/2017 10:53:46 | 15/07/2017 11:03:32 | 200 | 586 |
| Casius Data 5 | n/a | 15/07/2017 11:24:07 | 15/07/2017 11:33:58 | 199 | 590 |
| Casius Data 6 | n/a | 15/07/2017 11:45:53 | 15/07/2017 11:56:37 | 200 | 644 |
| Casius Data 7 | n/a | 15/07/2017 12:16:45 | 15/07/2017 12:26:27 | 200 | 583 |
| Casius Data 8 | n/a | 15/07/2017 12:36:27 | 15/07/2017 12:47:03 | 200 | 636 |
| Casius Data 9 | n/a | 15/07/2017 13:05:41 | 15/07/2017 13:15:31 | 200 | 590 |
| Casius Data 10 | n/a | 15/07/2017 13:25:18 | 15/07/2017 13:37:55 | 200 | 757 |

# 2D Scatter - Before CASIUS



Legend:
- ✕ Casius Data 1
- ✕ Casius Data 2
- ✕ Casius Data 3
- ✕ Casius Data 4
- ✕ Casius Data 5
- ✕ Casius Data 6
- ✕ Casius Data 7
- ✕ Casius Data 8
- ✕ Casius Data 9
- ✕ Casius Data 10
- ----- 1 Drms
- - - 2 Drms
- ——— Beacon
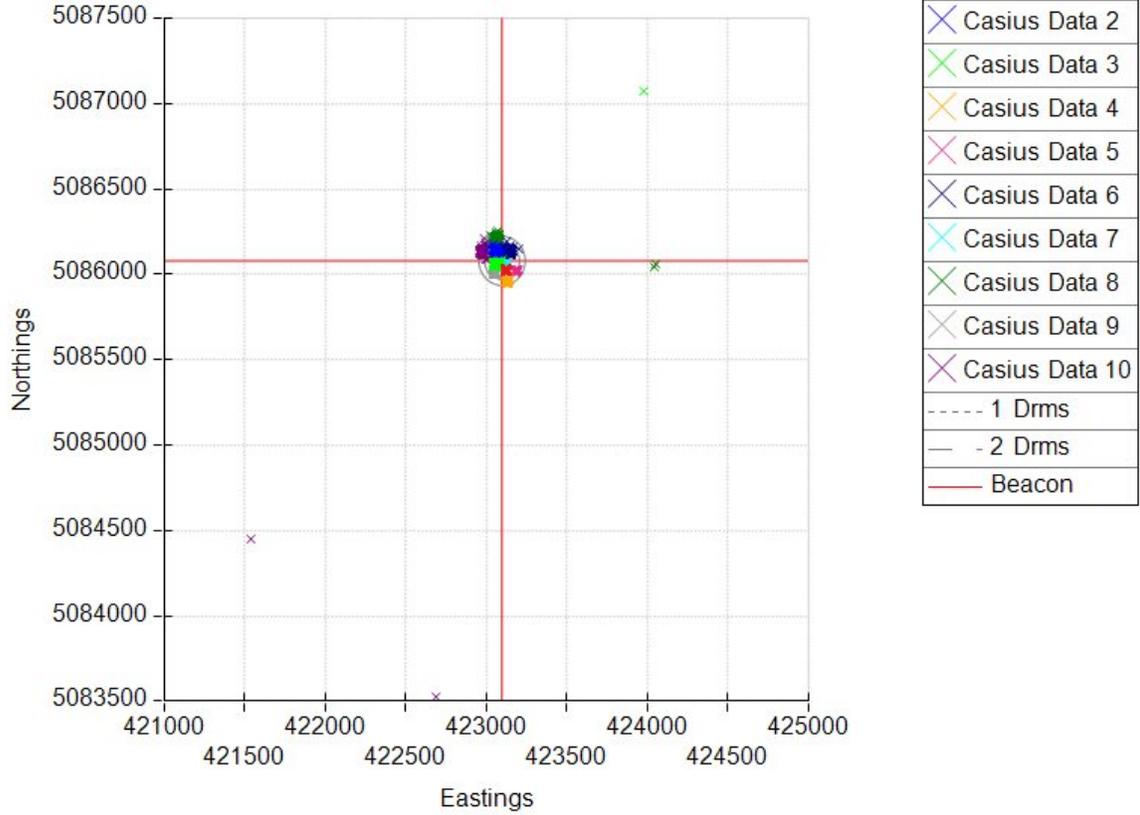
# 3D Histogram - Before CASIUS



Legend:
- 0.8 - 0.9
- 0.7 - 0.8
- 0.6 - 0.7
- 0.5 - 0.6
- 0.4 - 0.5
- 0.3 - 0.4
- 0.2 - 0.3
- 0.1 - 0.2
- 0 - 0.1

# 2D Scatter - After CASIUS



Northings (y-axis): 5083500 to 5087500
Eastings (x-axis): 421000 to 425000

Legend:
- ✕ Casius Data 1
- ✕ Casius Data 2
- ✕ Casius Data 3
- ✕ Casius Data 4
- ✕ Casius Data 5
- ✕ Casius Data 6
- ✕ Casius Data 7
- ✕ Casius Data 8
- ✕ Casius Data 9
- ✕ Casius Data 10
- ----- 1 Drms
- -- 2 Drms
- ——— Beacon
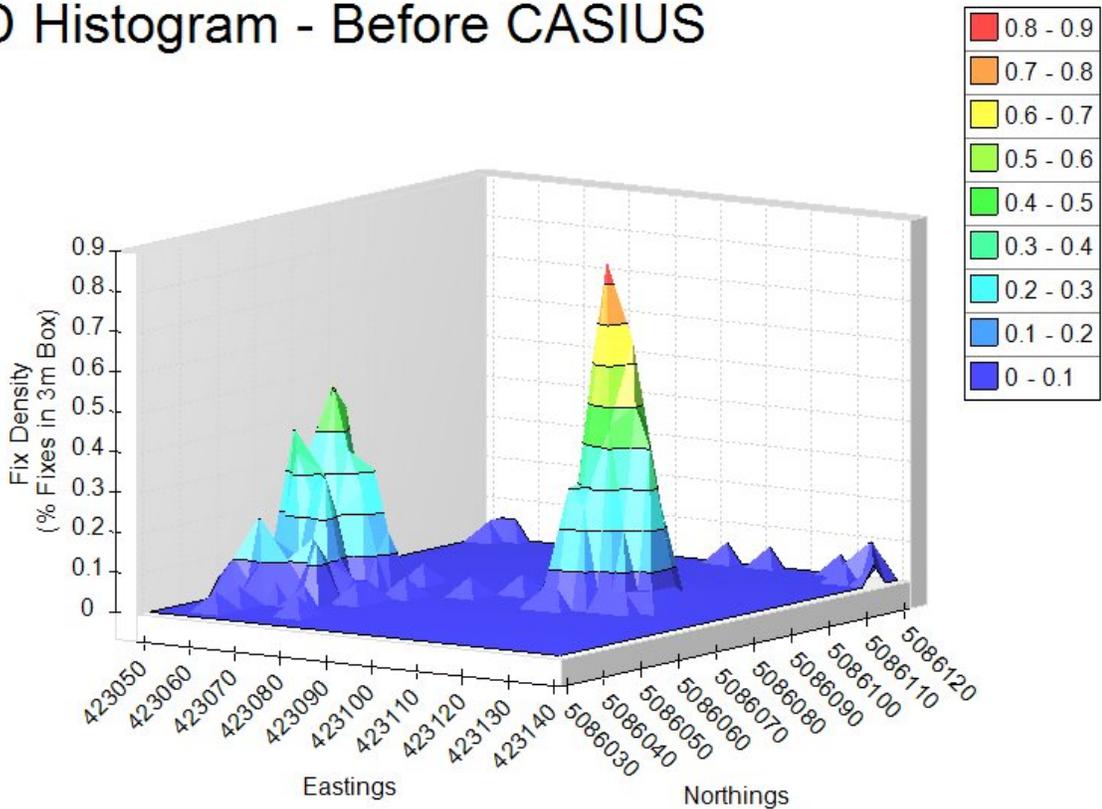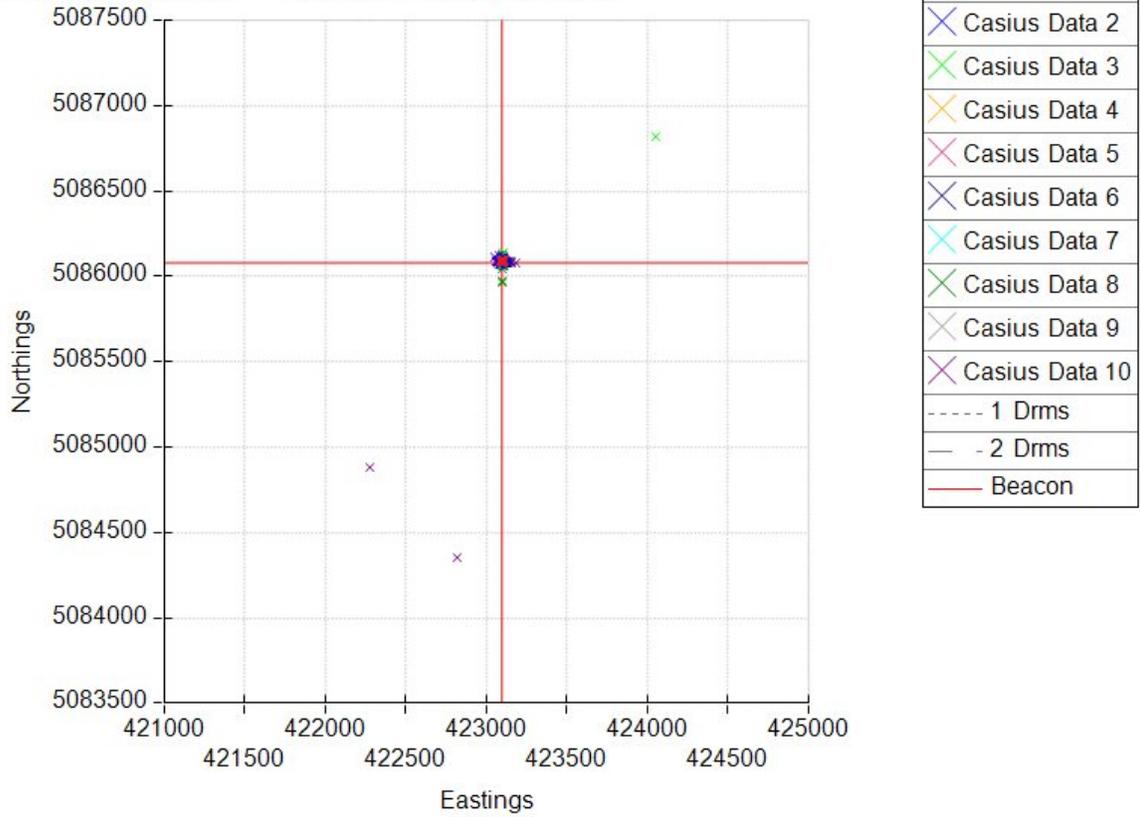
# 3D Histogram - After CASIUS



Fix Density (% Fixes in 3m Box)

Legend:
- 12 - 14
- 10 - 12
- 8 - 10
- 6 - 8
- 4 - 6
- 2 - 4
- 0 - 2