# CRUISE REPORT

# SOCIB Canales SUMMER 2018:

# 28th to 30th August 2018

*SOCIB_ENL_CANALES_AUG2018_SUMMER*

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|---|---|
| **Document type:** | Cruise report |
| **Date:** | 2018-08-30 |

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| **Description:** | A repeat seasonal hydrographic survey of the Balearic Sea, monitoring the Ibiza and Mallorca Channels. 28 CTD stations were carried out over 3 days; the stations forming two transects across the Ibiza Channel (IC) and one transect across the Mallorca Channel (MC). |
| **Authors:** | E. Alou, C. Muñoz, J. Allen, I. Lizarán |
| **Supervision:** | E. Alou |
| **Keywords:** | Mediterranean; ocean circulation; Balearic Sea; Ibiza Channel; Mallorca Channel; Northern Current; |

## DOCUMENT VERIFICATION LIST

| Date: | Checked by (name) | SOCIB division | Ref. |
|---|---|---|---|
| 2018-10-22 | C. Muñoz | SOS | |
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## CHANGE RECORD

| ver | Date | Description | Author | Checked by |
|---|---|---|---|---|
| 1.0.0 | 2018-08-28 | v1.0 of document | C. Muñoz | J. Allen |
| 1.1.0 | 2018-08-31 | v1.1 of document | E. Alou | J. Allen |
| 1.1.1 | 2019-06-10 | add links to data and CSR | C. Muñoz | C. Muñoz |
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Balearic Islands Coastal Observing and Forecasting System

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## Objectives

1. Provide seasonal water bottle calibrated CTD transects to calibrate near-continuous autonomous glider monitoring of the Ibiza Channel.

2. Complete repeat hydrographic survey of the Ibiza Channel (IC) and Mallorca Channel (MC) through deployment of a CTD instrument frame (SeaBird SBE911*plus*) with extra mounted sensors and rosette equipped with twelve 5 litre Niskin bottles.

3. Discrete water sample collection at various depths for the purpose of:
    a. Sensor field correction with the *in situ* discrete water samples for salinity, dissolved oxygen and chlorophyll a (chl *a*) concentration.
    b. Biogeochemical sampling of nutrients and phytoplankton community (through microscopic post-cruise analyses).

## Onboard personnel

| ID | Name | Role | Affiliation |
|---|---|---|---|
| 1 | Eva Alou | Chief Scientist /Lead biogeochemical sampling and analysis | SOCIB |
| 2 | Cristian Muñoz | CTD/Biogeochemical and salinity sampling | SOCIB |
| 3 | Nikolaus Wirth | Lead Technicians/Physics Tech/CTD | SOCIB |
| 4 | Irene Lizarán | Physics Tech/CTD/Salinity sampling | SOCIB |
| 5 | Carlos Castilla | Physics Tech/CTD | SOCIB |
| 6 | Inmaculada Ruiz | CTD/Biogeochemical sampling | CSIC |
| 7 | Andrea Cabornero | Biogeochemical sampling and analysis | SOCIB |

| | | | |
|---|---|---|---|
| 8 | Alejandro Segura | Biogeochemical sampling | UIB student |
| 9 | Lara Díaz | Biogeochemical sampling and analysis | CSIC |
| 10 | John Allen | Physics lead/salinity sampling | SOCIB |

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## Station plan

28 CTD stations were carried out over a period of 3 days; 2 transects in the IC and one transect across the Mallorca Channel (MC). The ADCP was not collecting data throughout the entire duration of the cruise. Figure 1 shows the station locations and the order in which stations were carried out.

A ship activity log detailing actions carried out during the cruise is provided in Appendix 1.

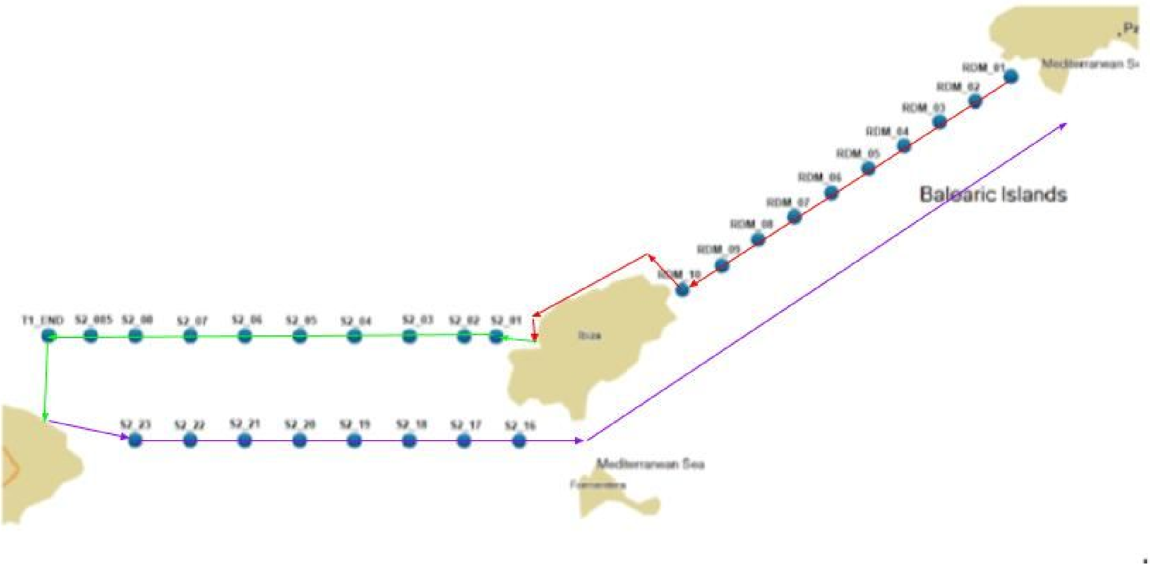


**Fig. 1**: Station plan

## Cruise diary

### Day 1 - 28th AUG 2018

*B/O SOCIB* slipped from her regular berth in Palma at ~06:15 GMT to steam out of Palma bay and begin the Mallorca Channel 'RadMed' section of the Summer '18 Canales cruise. This time we were without a VM-ADCP; both the transducer and deck unit were on their way to California for trouble-shooting and repair.

Station RadMed01 began at 07:46. The station was completed and the CTD secured on board by 07:57. Since the preceding cruises it appears at this early stage that the two conductivity sensors have continued to diverge, the salinity difference increasing from ~0.015 to ~0.022. Both these sensors are ready to go back for laboratory calibration as soon as they can be spared, probably after this Canales. In addition the cast suffered 2 or 3 significant spikes low in temperature at around 25 m depth in the upcast.

Station RadMed02 began at 08:23 and was completed by 08:34 GMT.

Station RadMed03 began at 09:03 and was completed by 09:15.

Station RadMed04 began at 09:39 and was completed by 09:50.

Station RadMed05 began at 10:15 and was completed by 10:40.

A surface drifter was launched at ~10:54 at 39° 18.06' N, 02° 01.26' E; this was a 10 m drogued drifter originally deployed during the PreSWOT cruise in May, but soon after 'recovered' by a fisherman.

Station RadMed06 began at 11:10 and was completed by 11:35.

Station RadMed07 began at 12:03 and was completed by 12:34. During these deeper stations, it looked as though the difference between the two conductivity sensors had perhaps not diverged as much as we had at first thought, possibly equivalent to a salinity difference more around 0.018-0.019.

Station RadMed08 began at 13:02 and was completed by 13:31.

Station RadMed09 began at 14:00 and was completed by 14:18.

Station RadMed10 began at 14:47 and was completed by 14:57, at which point *B/O SOCIB* set course for the transit around the north coast of Ibiza, heading for St. Antonio. *B/O SOCIB* was alongside by 17:00 GMT.


**Fig. 2**: CTD operation in Mallorca Channel

# DAY 2 - 29th AUG 2018

*B/O SOCIB* slipped from St. Antonio at 06:00 (GMT) and headed towards the beginning of the Northern Ibiza Channel section.

Station S2_01 began at 06:44 and was completed by 06:54.

Station S2_02 began at 07:16 and was completed by 07:30.

Station S2_03 began at 08:02 and was completed by 08:32.

The main CTD at station S2_04 began at 09:07 and was completed by 09:49. We had by this time determined that we were not getting sensible oxygen data from the SBE43 oxygen sensor on loan from UTM. However the SBE 43 oxygen sensor that we had previously used from our original internally recording SeaBird series 25 backup CTD we had also written off as dysfunctional on previous Canales cruises. To try to narrow down the problem, we decided to carry out a parallel cast using the Seabird 25 CTD unit, in an attempt to check that the problem was not with the Seabird 9 channel used for oxygen on our main CTD frame. This would also serve as a useful inter-comparison for the little used Seabird 25 CTD unit. The Seabird 25 CTD cast, S2_04_SB25, began at 10:03, a very rapid turnaround by the crew bearing in mind an extra block had to be added to the A-Frame to take the non-conducting cable. By 10:40, the Seabird 25 CTD unit had been recovered and B/O SOCIB had begun steaming towards station S2_05. Sadly, a subsequent inspection of the data files on the SBE 25 CTD unit showed that no data had been recorded for the entire cast.

S2_05 CTD station began at 11:17 and was completed by 11:55.

Station S2_06 began at 12:29 and was completed by 13:09.

Station S2_07 began at 13:41 and was completed by 14:13. A second attempt to carry out a Seabird 25 CTD cast at this station, S2_07_SB25, to a depth of 500 m, began at 14:18. This followed a number of deck tests around lunch-time earlier to check that we could get the CTD unit to record a data file. By 14:41, the Seabird 25 CTD unit had been recovered and B/O SOCIB had begun steaming towards station S2_08. Sadly, despite the dry tests earlier in the day the Seabird 25 CTD unit failed to record a data file in water profile; as before it wrote a header into the file and then stopped recording.

Station S2_08 began at 15:14 and was completed by 15:31. At this point a shallow wet test began for the SBE 25 CTD unit, S2_08_SB25, to a depth of just ~ 20 m. The test was over by 15:37; subsequent inspection showed that this time it recorded data as required.

The CTD cast at station S2_085 began at 16:03 and was completed by 16:13.

The final station of this leg and of the day, T1 END, began at 16:40 and was completed by

16:48. On leaving the station, *B/O SOCIB* set course for Denia on the Spanish mainland. *B/O SOCIB* was alongside and tied up by 17:50 (GMT).

**Fig. 3**: The canales summer 2018 scientific and technical team

## DAY 3 - 30th AUG 2018

*B/O SOCIB* slipped from Denia at 05:49 (GMT), and set course for the first station of the southern Ibiza Channel section. Thankfully the forecast from the previous few days was now easing, but what sea we get will be on the nose all the way, so fingers were crossed.

Station S2_23 began at 06:53, but was recovered from only 60 m due to a winch scrolling gear problem. Following adjustment of the scrolling gear, the cast was restarted from the surface at 07:04 and was completed by 07:11. Small dynamic looking storms on the horizon dead ahead would have some future influence we felt sure !.

Station S2_22 began at 07:43 and was completed by 08:00. During the station, everyone was mesmerised by the storm over the direction of the next stations, two water spouts appeared to form, and a fabulous daytime lightning display made it even more amazing to watch.

Station S2_21 began at 08:31 and was completed by 09:06; in what looked like the eye of the storm.

Station S2_20 began at 09:37 and was completed by 10:14.

Station S2_19 began at 10:45 and was completed by 11:15.

Station S2_18 began at 11:47 and was completed by 12:12.

Station S2_17 began at 12:44 and was completed by 12:53.

Station S2_16 began at 13:25 and was completed by 13:33; at which time *B/O SOCIB* set course for Palma, with the weather and sea state still much better than forecast, the shorter but more exposed southern route around Ibiza was selected. After an uncomfortable passage across the Mallorca Channel, *B/O SOCIB* was alongside and tied up by 20:00 (GMT).

**Fig. 4**: Storm brewing over station S2_21 in the southern section of Ibiza Channel

## Instrumentation description and configuration

In this section are described the instrumentation and the configuration used during the cruise

### CTD-Probe

| | |
|---|---|
| **Manufacturer:** | SeaBird |
| **Model:** | SBE9+ |
| **S/N:** | 09P63579-1023 |
| **SOCIB Inventory:** | SCB-SBE9001 |
| **Deck Unit:** | SBE11 |
| **SOCIB Inventory:** | UTM-SBE11 |

Details of the configuration file available in Appendix 2 of this report

| Sensor | Model | S/N | Calibration date |
|---|---|---|---|
| Temperature | SBE 3P | 03P5391 | 2016/02/05 |
| Temperature 2 | SBE 3P | 03P5425 | 2011/05/15 |
| Conductivity | SBE4C | 043718 | 2016/02/11 |
| Conductivity 2 | SBE4C | 043907 | 2011/04/28 |
| Pressure | 0- 10.000psia | 1023 | 2016/02/17 |
| Oxygen | SBE 43 | 1278 | 2016/04/12 |
| Transmissometer | WET Labs C-Star 25-650 | CST-1419DR | 2011/04/15 |
| Turbidity | STM Sea Point | 12182 | 2011 |

| | | | |
|---|---|---|---|
| Fluorometer | Seapoint 6000m | 3259 | 2011 |
| Irradiance | PAR Biospherical QCP-2300L-HP | 70364 | 2011/03/28 |
| Surface Irradiance | SPAR Superficie Biospherical QCR2200 | 20519 | 2016/04 |
| Altimeter | Datasonics PSA-916D | 69894 | 2016 |

### Configuration

For controlling the CTD the following file was used: 2018-08-28_1023_SOCIB.xmlcon. The information contained in that file is located in Appendix2: CTD Configuration File in SOCIB-Canales Summer18

### Thermo-salinometer

| | |
|---|---|
| **Manufacturer:** | SeaBird |
| **Model:** | SBE21 |
| **S/N:** | 3370 |
| **SOCIB Inventory:** | SCB-TSL001 |
| **Calibration date:** | 2018/07/03 |


### Configuration

The data are collected using the UTM - Termosal.exe software. The data are stored directly in the main desktop and are processed through the SOCIB-DC system.

**Weather Station**

| | | |
|---|---|---|
| **Manufacturer:** | Geonica |  |
| **Model:** | Meteodata 2000 | |
| **S/N:** | | |
| **SOCIB Inventory:** | SCB-MET009 | |
| **Calibration date:** | 2011 | |



## Configuration

The data are collected using the UTM - SADO System. The data are stored directly in the main desktop and are processed through the SOCIB-DC system.

# Scientific Reports

## Physical data report

The following contains an overview of the physical data collected from the CTD on board the R/V SOCIB catamaran from the 28th to the 30th August 2018. The first section section briefly outlines the steps followed in order to process the CTD data. The second section provides a brief biogeochemical data report, after which some results are presented from the CTD, drawing attention to any particularly interesting features.

### CTD and water bottle sampling

***Data acquisition:*** CTD casts were carried out at 28 stations encompassing 2 transects across the IC and one transect in the MC. At each station, water samples were collected with the rosette at various depths for measuring *in situ* salinity, dissolved oxygen and fluorescence in order to apply corrections to the conductivity, oxygen and fluorescence sensors. Nutrients samples were also taken. Refer to the available logbook generated during the cruise for more details on sampling depths, replicates and parameters sampled at each station.

***Data preprocessing and visualization***: The sensor data were processed using SBE (Sea-Bird Electronics) Data Processing Version V7 23.2 (for details refer to SBE Web site). The resulting data are then processed in Matlab in order to provide the figures in the following section. Post cruise processing will involve the correction of the salinity data based on calibration with in situ water samples analysed in the lab with a Guildline Portasal model 8410A salinometer. The biogeochemical sampling will be discussed in the next section: the biogeochemical report.

## Biogeochemical data report

As mentioned in the general objectives, the primary objective of the biogeochemical data collection during this cruise is to compare the CTD oxygen (SBE-43) and fluorescence (Seapoint) sensors against the *in situ* discrete water samples of these parameters.

Secondary field objectives are:

1. To estimate chl *a* concentration and distribution (as a proxy for phytoplankton biomass).
2. To assess nutrient concentration distribution: Nitrate ($NO_3^-$), nitrite ($NO_2^-$), silicate ($SiO_4^{2-}$) and phosphate ($PO_4^{3-}$).
3. To study phytoplankton community composition.

The sampling was carried out on 3 days from the 28th to the 30th August 2018 and followed the established R/V SOCIB protocols.

### Dissolved oxygen

Discrete water samples (Winkler's method, Langdon 2010, see protocols) for comparison were taken at each station along each transect at a maximum of 3 depths. We chose depths of varying oxygen concentrations (in order to sample the full spectrum of oxygen concentrations). Refer to the available logbook generated during the cruise for more details on sampling depths, replicates and parameters sampled at each station.

Samples were analyzed on board after an 8-12 h period in darkness with a titration procedure with potentiometric endpoint detection (Metrohm 888 Titrator).

The final dissolved oxygen dataset will be produced post-cruise following the analysis of the data.

### Chl *a* concentration

Samples for chl *a* concentration were taken at all stations at 4 depths (see logbook for details). Post-cruise chl *a* determination will be carried out at the IMEDEA by fluorometry (Turner 10-AU fluorometer, see available protocol).

### Nutrients

Samples for inorganic nutrient concentrations were taken at all stations at a maximum of 9 depths (see logbook for detailed information on sampling depths and protocols). Samples will be kept frozen at -20ºC at the IMEDEA until analysis.

### Phytoplankton community composition

Samples were taken on some stations at the deep chlorophyll maximum (DCM, see logbook) for general cell identification (cells fixed in Lugol's solution, Utermöhl 1958). Samples for microscopy will be analyzed post-cruise at the IMEDEA.

# Preliminary results

## Preliminary physical results

### 1. Hydrography: T-S diagram

Figure 5, Figure 6 and Figure 7 show the potential temperature – salinity distribution of all stations of the entire water column, where colour indicates the longitude of the corresponding station. The most saline surface water is typically found in the western part of the Ibiza Channel. In contrast the eastern part of the Ibiza Channel shows some of the freshest surface water signals.

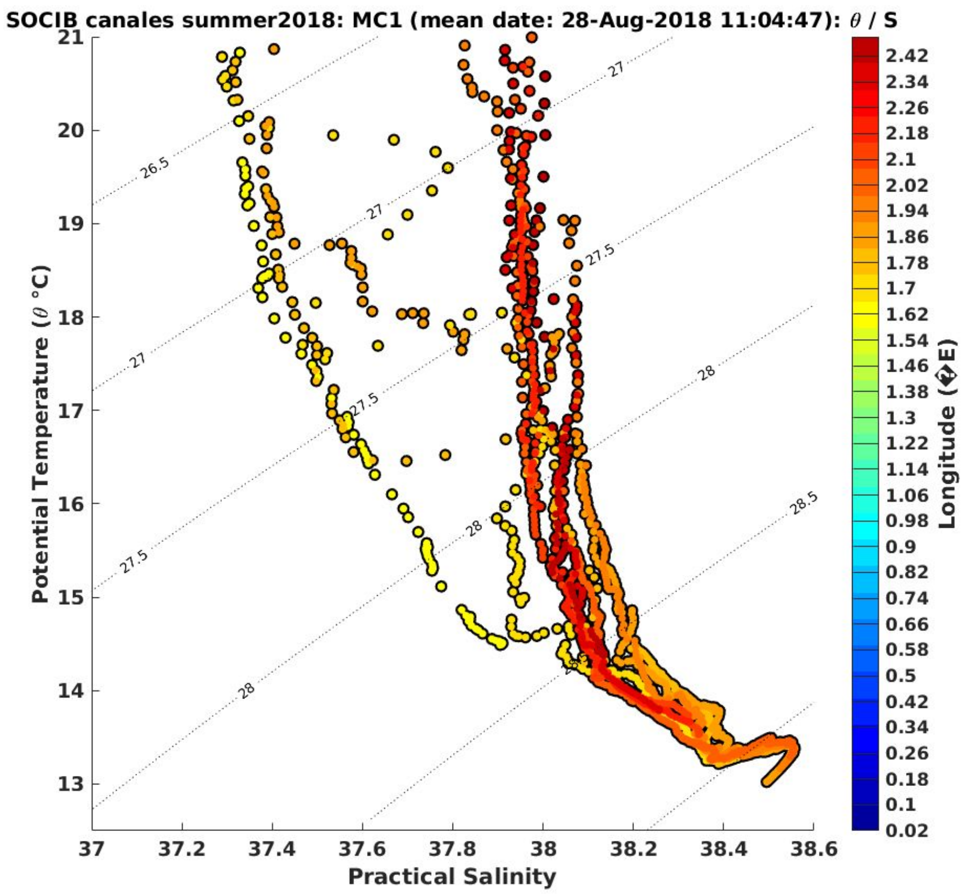


**Fig 5**. T-S diagram of all MC stations; the colour bar indicates the longitude of the station; thus the colour spectrum from red to blue corresponds to the MC transect, from East to West.

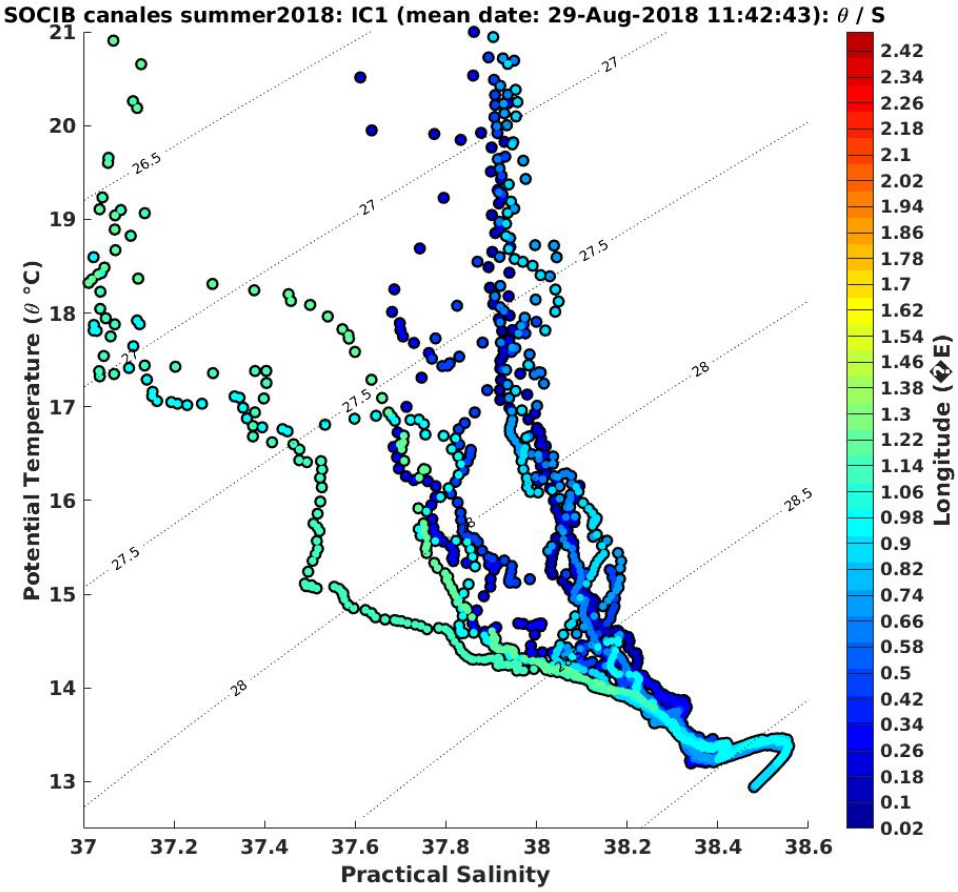


**Fig 6**. T-S diagram of all IC1 stations; the colour bar indicates the longitude of the station; thus the colour spectrum from red to blue corresponds to the IC1 transect, from East to West.

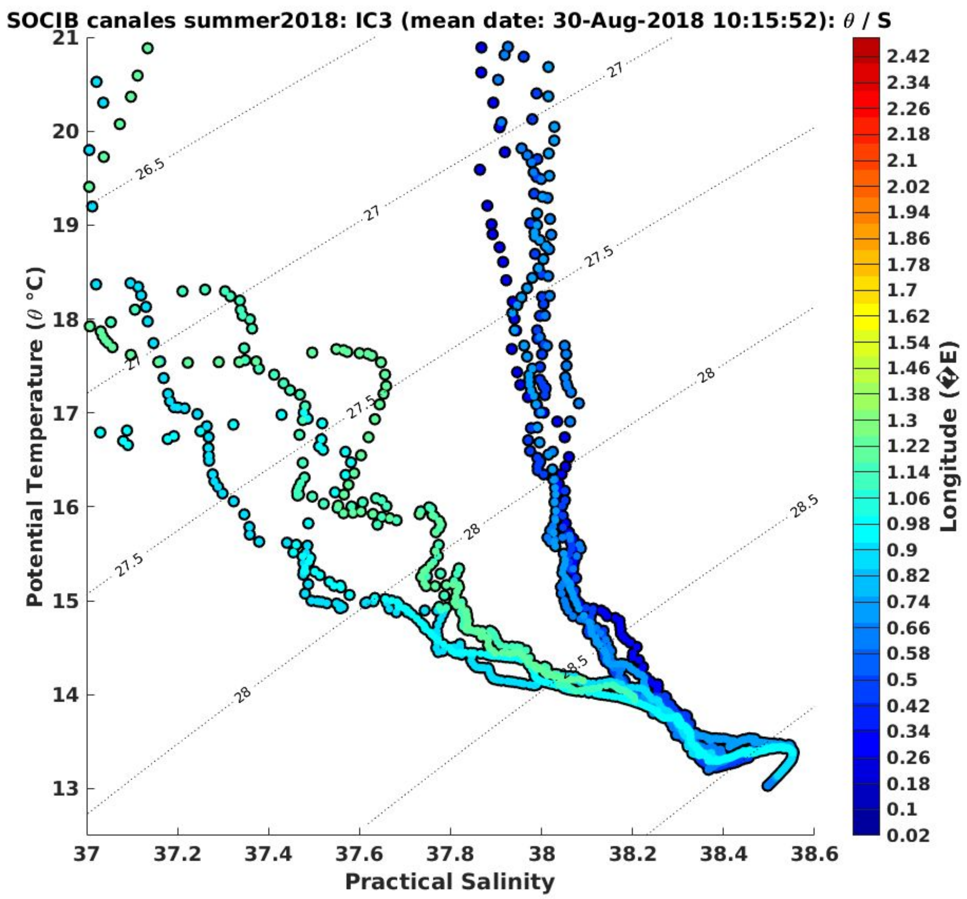


**Fig 7**. T-S diagram of all IC3 stations; the colour bar indicates the longitude of the station; thus the colour spectrum from red to blue corresponds to the IC3 transect, from East to West.

## 2. Ibiza Channel: North

The figures presented in this section are showing the most northerly transect of the IC. Figure 8 shows the different variables acquired through the CTD profiles across the northern IC covering from 0.1º E (peninsula shelf) til 1.2º E (Ibiza shelf). Profiles are shown only in the upper section ~300m depth.

Potential temperature (figure 8a) has a stratified vertical distribution presenting a strong temperature gradient between 22ºC and 14.5ºC. The vertical gradient presents a slightly more concentrated distribution in the western area (Ibiza shelf) from 0.7ºE until 1.2ºE.

Salinity (figure 8b) presents typical horizontal gradients on the continental shelves that are wider distributed around the Ibiza shelf than in the peninsula shelf. Salinity vertical distribution range is 37 psu - 38.6 psu.

Potential density (figure 8c) presents a stratified vertical distribution characterized by strong gradients between 26 and 29 kg/m3. Like the salinity, it does exist a stronger horizontal gradient in the Ibiza shelf side from 0.7ºE to 1.2ºE.

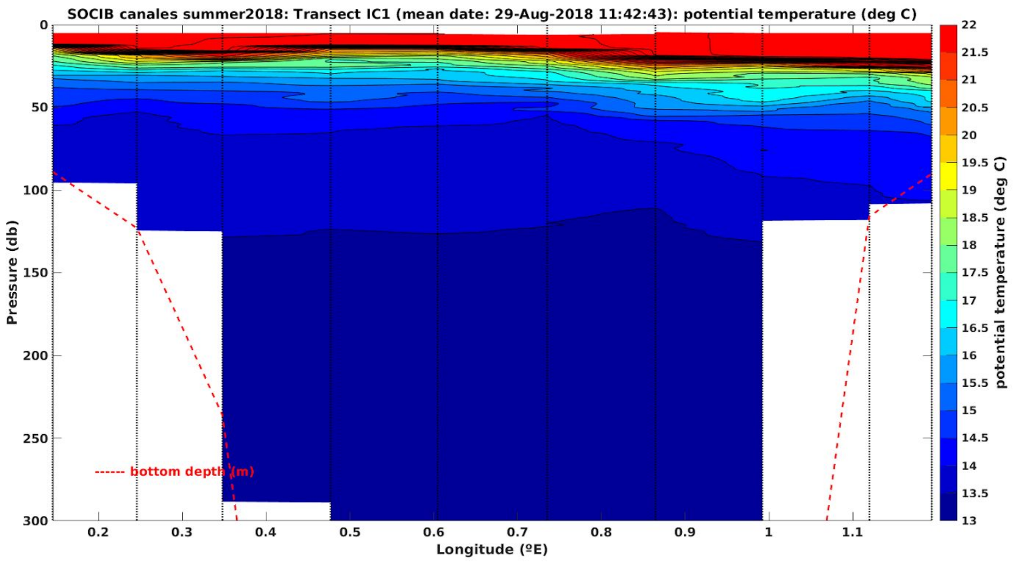


**Fig. 8a**. Potential temperature (ºC) of the first (most northerly) transect of the IC (only the upper 300 m of the water column is shown in order to highlight the subsurface lense centred at 0.6º E).

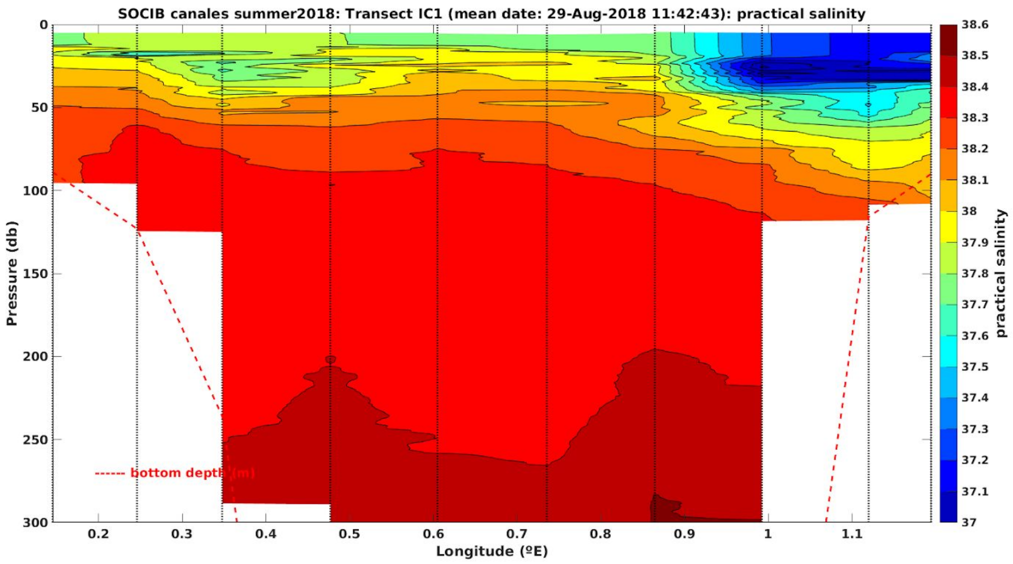


**Fig. 8b.** Salinity of the first (most northerly) transect of the IC (only the upper 300 m of the water column is shown in order to highlight the subsurface lense centred at 0.6º E, most pertinent in density in fig. 8c).

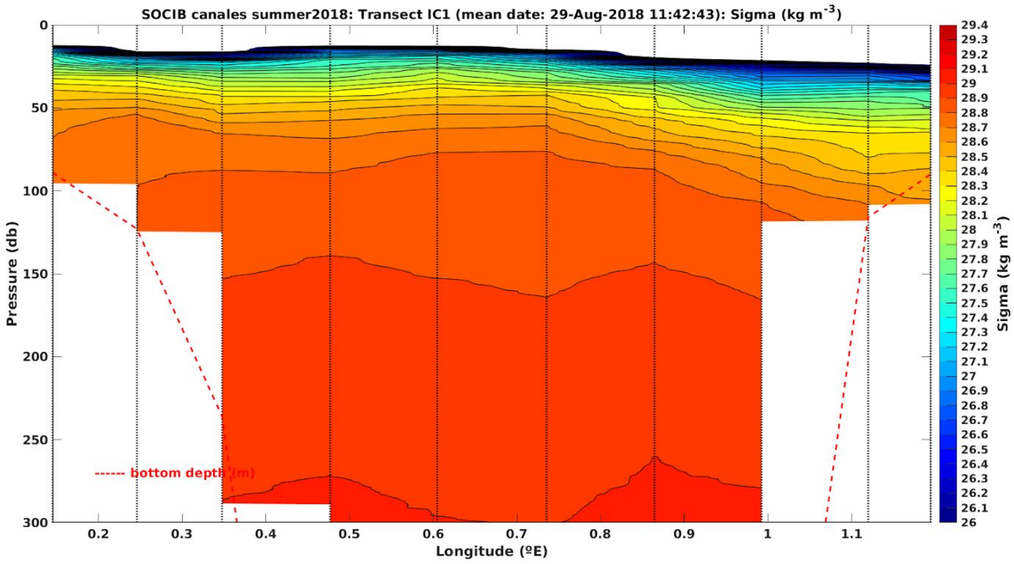


**Fig. 8c.** Potential density (kg $m^{-3}$) of the first (most northerly) transect of the IC (only the upper 300 m of the water column is shown in order to highlight the subsurface lense centred at 0.6º E).

## 4. Ibiza Channel: South

Figure 9 shows the different variables acquired through the CTD profiles across the southern IC covering from 0.1º E (peninsula shelf) til 1.2º E (Ibiza shelf). Profiles are shown only in the upper section ~300m depth.

Potential temperature (figure 9a) has a clear stratified vertical distribution presenting a strong temperature gradient between 14.5ºC and 22ºC.

Salinity (figure 9b) presents typical horizontal gradients on the continental shelves that are wider distributed around the Ibiza shelf than in the peninsula shelf. Salinity vertical distribution range is 37 psu - 38.6 psu.

Potential density (figure 9c) presents a stratified vertical distribution characterized by strong gradients between 26 and 29.4 kg/m3. Like the salinity, it does exist a stronger horizontal gradient in the Ibiza shelf side from 0.8ºE to 1.2ºE.

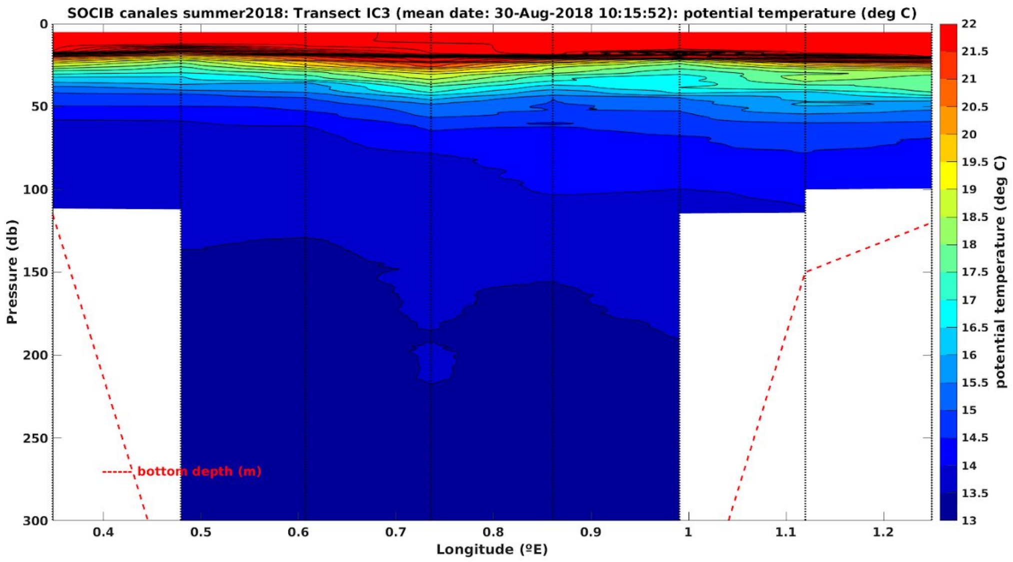


**Fig. 9a.** Potential temperature (ºC) of the southernmost IC cross-section.

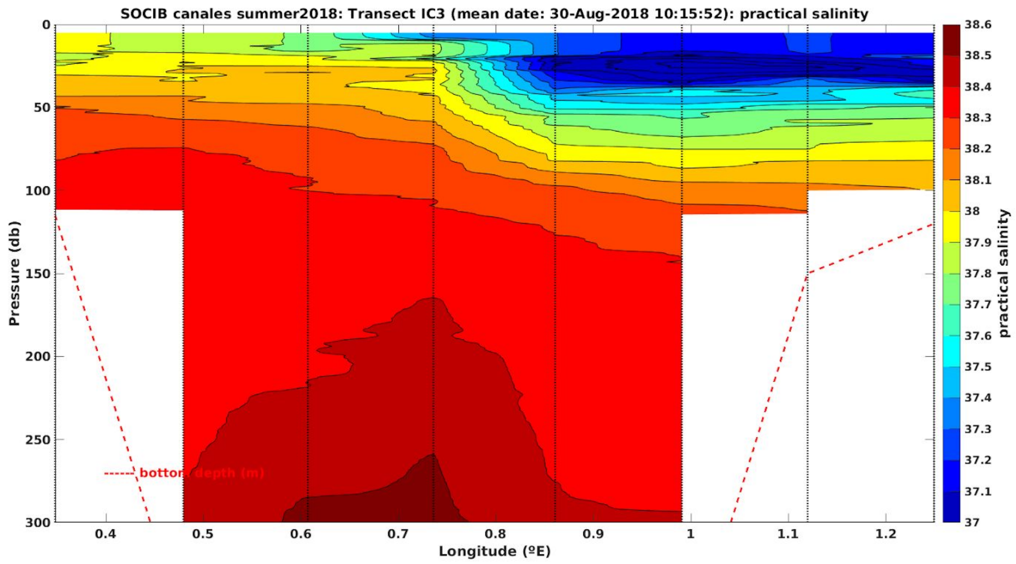


**Fig. 9b.** Salinity of the southernmost IC cross-section.

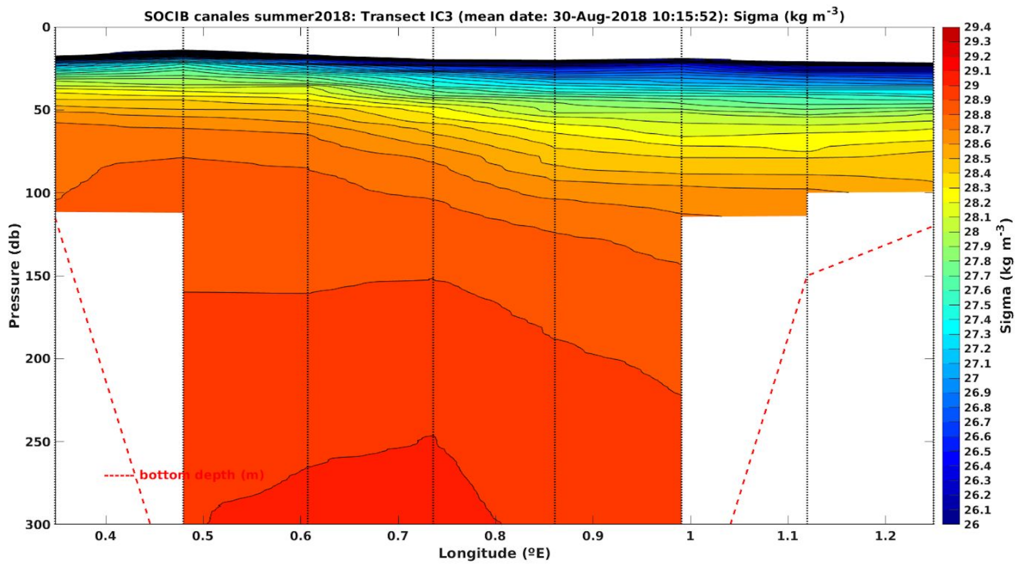


**Fig. 9c.** Potential density (kg $m^{-3}$) of the southernmost IC cross-section.

## 5. Mallorca Channel

Figure 10 shows the different variables acquired through the CTD profiles across the southern MC covering from 1.6º E (Ibiza shelf) til 2.4º E (Mallorca shelf). Profiles are shown only in the upper section ~300m depth.

Potential temperature (figure 10a) has a clear stratified vertical distribution presenting a strong temperature gradient between 13ºC and 22ºC.

Salinity (figure 10b) presents typical horizontal gradients on the continental shelves that are wider distributed around the Ibiza shelf than in the Mallorca shelf. Salinity vertical distribution range is 37 psu - 38.6 psu.

Potential density (figure 10c) presents a stratified vertical distribution characterized by strong gradients between 26 and 29.4 kg/m3.

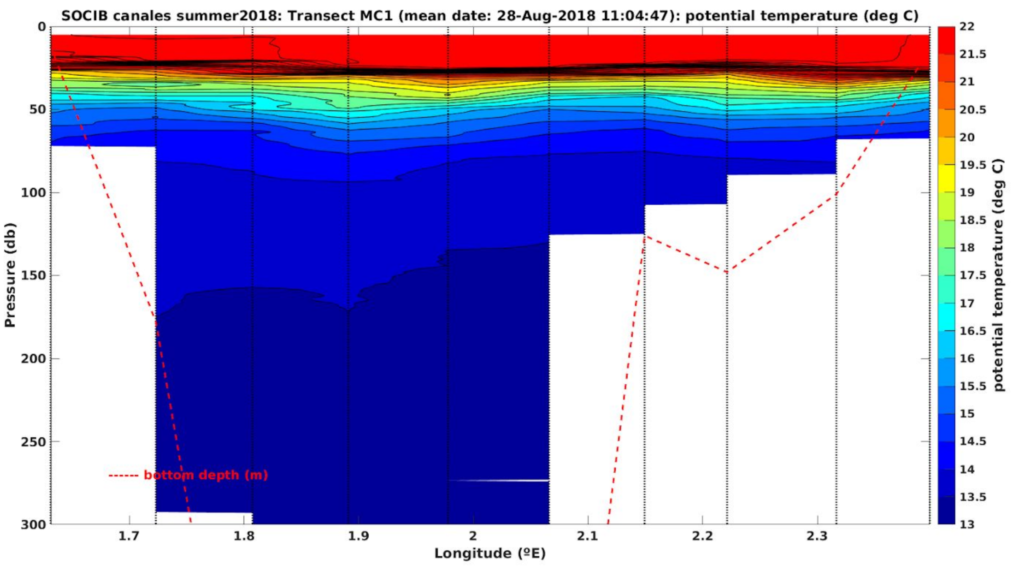


**Fig. 10a.** Potential temperature (ºC) of the southernmost MC cross-section.

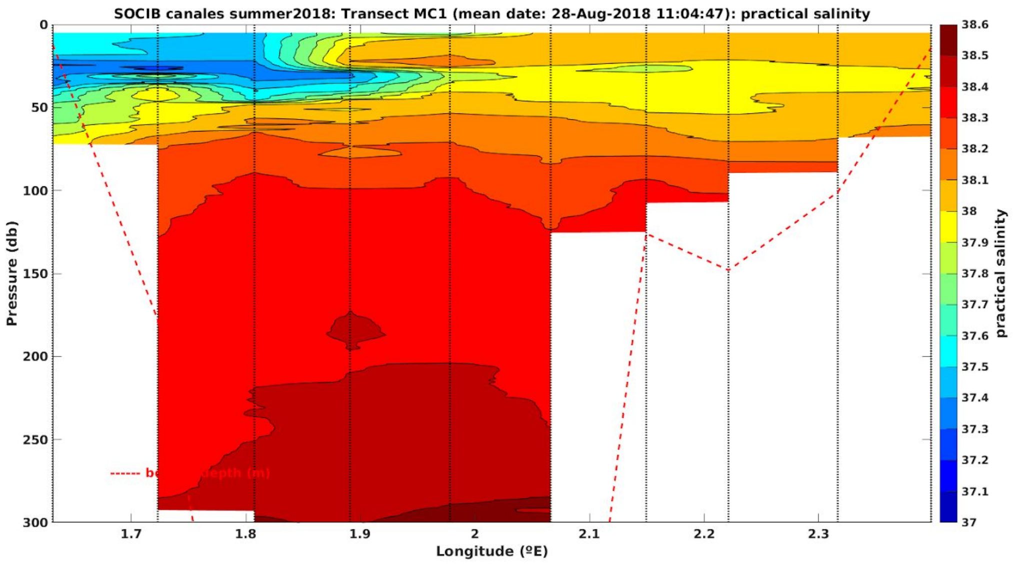


**Fig. 10b.** Salinity of the southernmost MC cross-section.

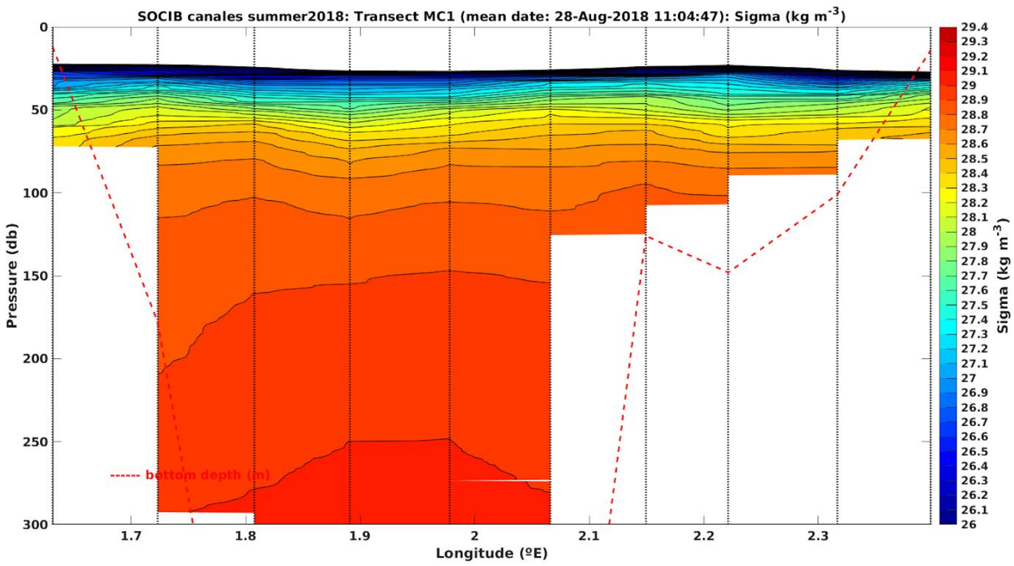


**Fig. 10c.** Potential density (kg $m^{-3}$) of the southernmost MC cross-section.

## Preliminary biogeochemical results

The final biogeochemical dataset will be produced in due course following post-cruise analysis of the data.

### 1. Ibiza Channel

Below we present some preliminary results obtained with the CTD sensors for dissolved oxygen (Fig. 11a, 12a) and *in vivo* fluorescence (Fig. 11b, 12b) of northernmost and southernmost transects of the IC respectively and in the upper 300 m depth.

The influence of the stratification of the water column on the distribution of the phytoplankton cells is seen in the figures (Fig 11a, 12a, 11b, 12b). The highest dissolved oxygen concentrations (6.6-8.09 mg $l^{-1}$) are found from 10 to 60 m depth, this being related to the presence of phytoplankton as is indicated by the distribution of chl a fluorescence (see figures 11b and 12b).

The chl a fluorescence maximum values (roughly 1.3 ug $l^{-1}$) are found in the Ibiza shelf side from 0.8ºE to 1.2ºE in both the northernmost and southernmost transects of the IC.

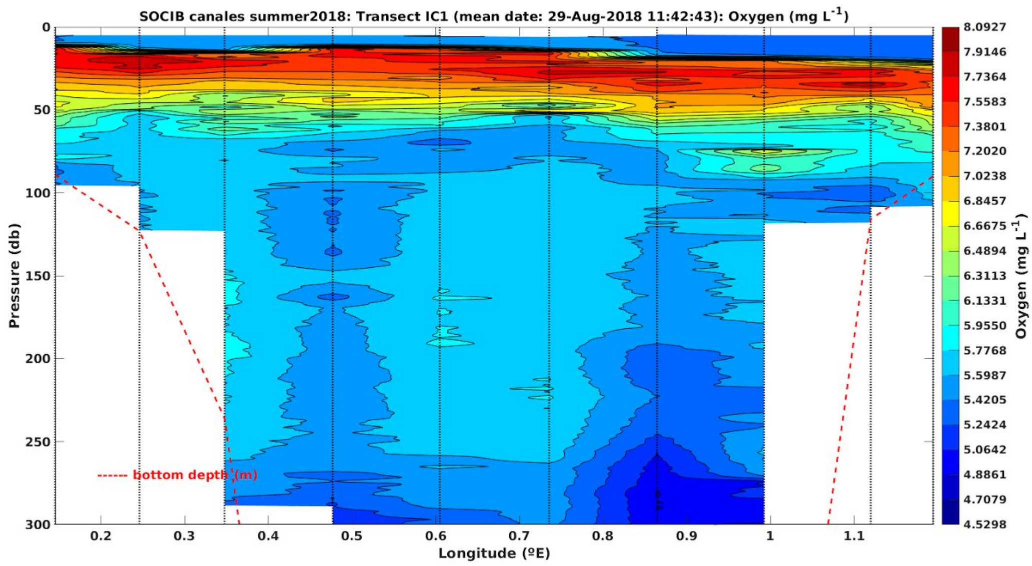


**Fig. 11a**: Initial figure for dissolved oxygen distribution obtained during the northern transect of the IC

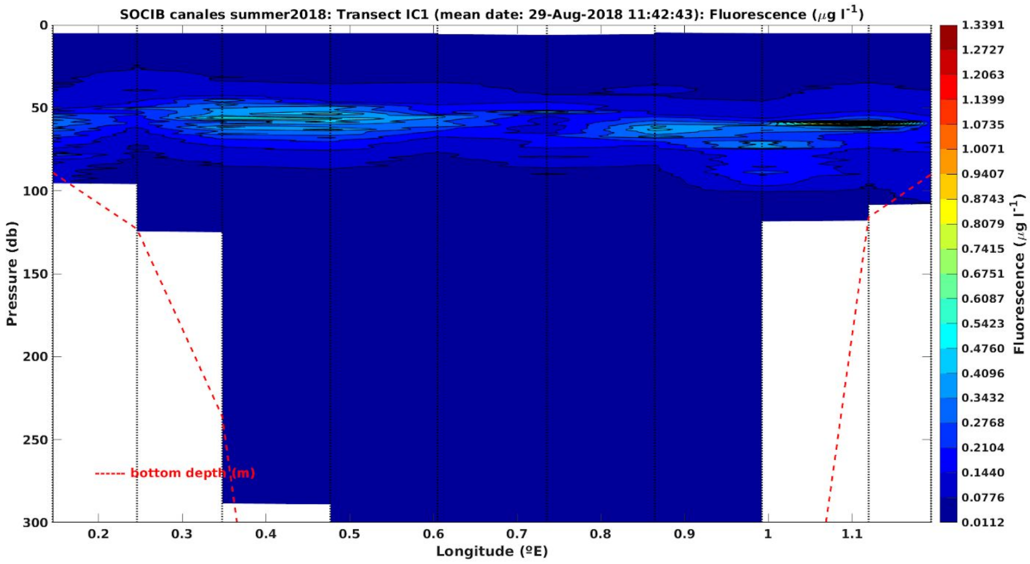


**Fig. 11b**: Initial figure for fluorescence distribution obtained during the northern transect of the IC

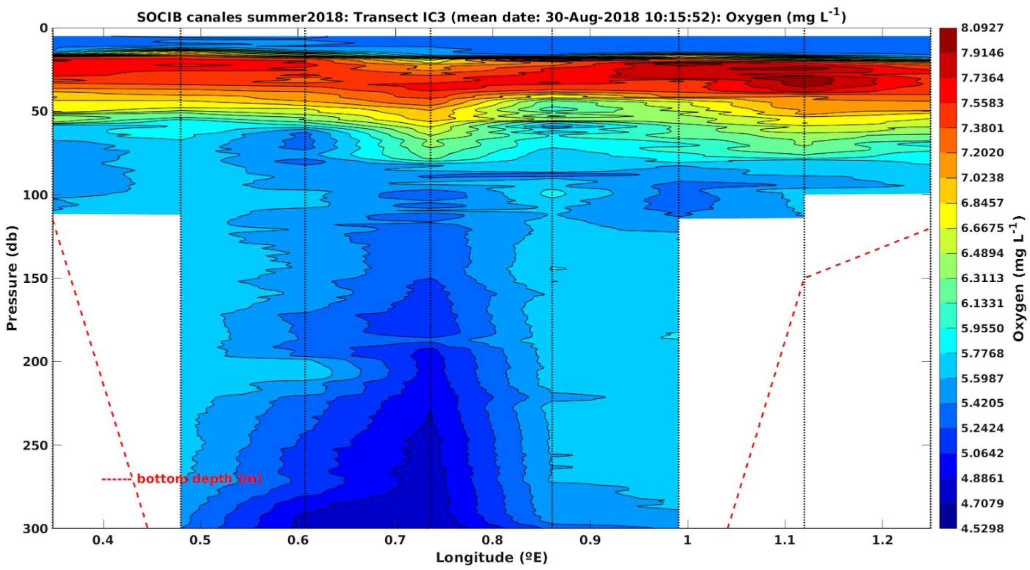


**Fig. 12a**: Initial figure for dissolved oxygen concentration distribution obtained on the southernmost IC cross-section.

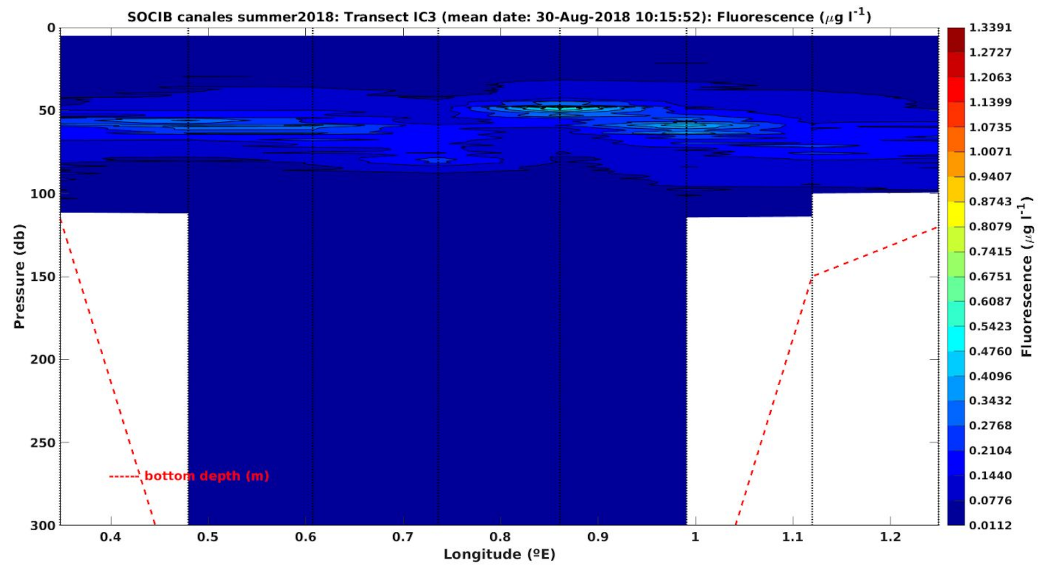


**Fig. 12b**: Initial figure for fluorescence distribution obtained on the the southernmost IC cross-section.

## 2. Mallorca Channel

Below we present some preliminary results obtained with the CTD sensors for dissolved oxygen and *in vivo* fluorescence (Fig. 13a, 13b) of the transect of the MC. The upper 300 m depth sections are presented. The oxygen and the chlorophyll a fluorescence follow similar distribution as seen in the Ibiza Channel as the values: dissolved oxygen concentrations ranging from 6.6 to 8.09 mg $l^{-1}$ and chlorophyll a fluorescence from 0.2 to 1.2 ug $l^{-1}$.

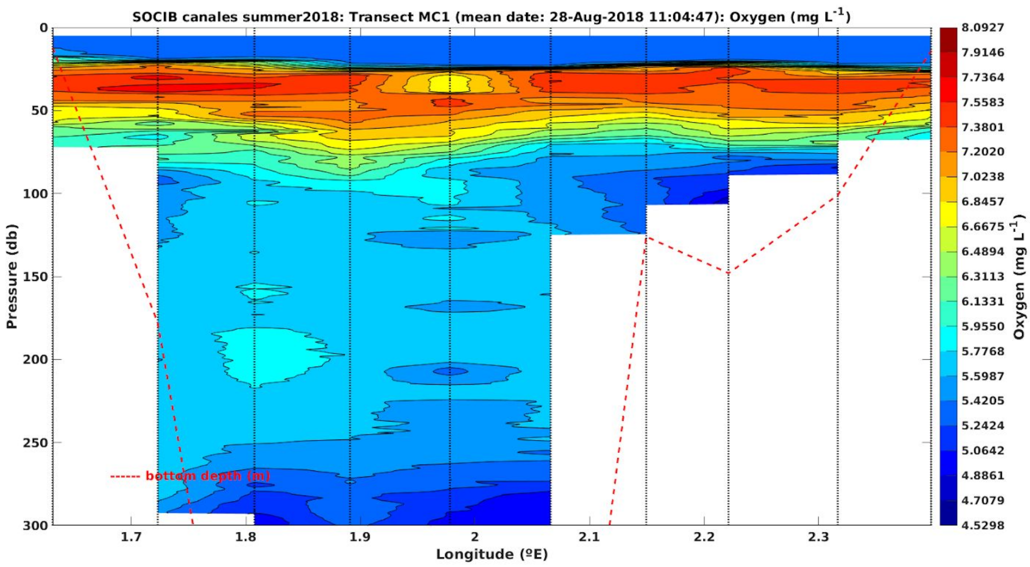


**Fig. 13a**: Initial figure for dissolved oxygen distribution obtained during the northern transect of the IC

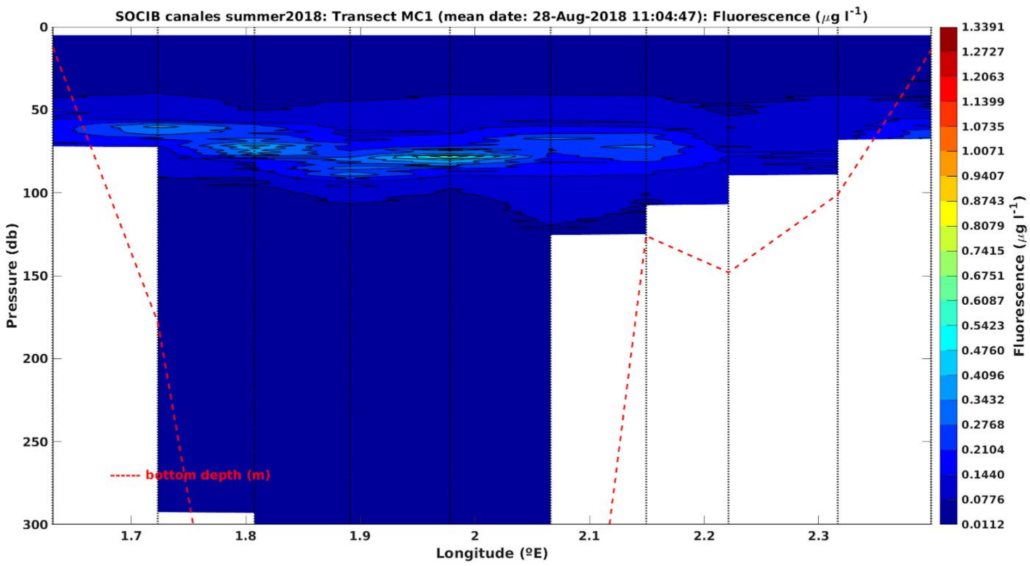


**Fig. 13b**: Initial figure for fluorescence distribution obtained during the northern transect of the IC

## Seadatanet Cruise Summary Report Link

The SDN-ICES Cruise Summary Report that references to this cruise is available through the following link:

http://seadata.bsh.de/Cgi-csr/retrieve_sdn2/csrreport.pl?project=SDN&session=41078&v1=10&v2=4&pcode=

## Processed Data Repository

| Data Source | Thredds URL |
|---|---|
| Position | http://thredds.socib.es/thredds/catalog/research_vessel/gps/socib_rv-scb_pos001/L1/2018/08/catalog.html?dataset=research_vessel/gps/socib_rv-scb_pos001/L1/2018/08/dep0051_socib-rv_scb-pos001_L1_2018-08-28.nc |
| Thermosal | http://thredds.socib.es/thredds/catalog/research_vessel/thermosalinometer/socib_rv-scb_tsl001/L1/2018/08/catalog.html?dataset=research_vessel/thermosalinometer/socib_rv-scb_tsl001/L1/2018/08/dep0046_socib-rv_scb-tsl001_L1_2018-08-28.nc |
| Weather Station | http://thredds.socib.es/thredds/catalog/research_vessel/weather_station/socib_rv-scb_met009/L1/2018/08/catalog.html?dataset=research_vessel/weather_station/socib_rv-scb_met009/L1/2018/08/dep0046_socib-rv_scb-met009_L1_2018-08-28.nc |
| CTD | http://thredds.socib.es/thredds/catalog/research_vessel/ctd/socib_rv-scb_sbe9001/L1/2018/catalog.html?dataset=research_vessel/ctd/socib_rv-scb_sbe9001/L1/2018/dep0011_socib-rv_scb-sbe9001_L1_2018-08-28.nc |
| VM-ADCP | - |

## References


Langdon C. (2010). Determination of dissolved oxygen in seawater by Winkler titration using the amperometric technique. In: Sloyan B.M., Sabine C. (Eds). GO–SHIP repeat hydrography manual: A Collection of Expert Reports and guidelines. IOC/IOCCP. Paris.

Utermöhl H. (1958). Zur Vervollkomnung der quantitativen Phytoplankton-Methodik. Mitteilungen der internationale Vereinigung für theorische und angewandte Limnologie 9:1–38.


## APPENDIX 1: Activities through Canales Summer 2018 Cruise

For a table of all ship activities logged during the campaign, refer to the excel file, SHIP_LOGBOOK.

## APPENDIX 2: CTD configuration file in SOCIB-Canales Summer18

**2018-08-30_1023_SOCIB.XMLCON**


```
<?xml version="1.0" encoding="UTF-8"?>
<SBE_InstrumentConfiguration SB_ConfigCTD_FileVersion="7.23.0.2" >
 <Instrument Type="8" >
  <Name>SBE 911plus/917plus CTD</Name>
  <FrequencyChannelsSuppressed>0</FrequencyChannelsSuppressed>
  <VoltageWordsSuppressed>0</VoltageWordsSuppressed>
  <ComputerInterface>0</ComputerInterface>
  <!-- 0 == SBE11plus Firmware Version >= 5.0 -->
  <!-- 1 == SBE11plus Firmware Version < 5.0 -->
  <!-- 2 == SBE 17plus SEARAM -->
  <!-- 3 == None -->
```

```
<DeckUnitVersion>0</DeckUnitVersion>
<ScansToAverage>1</ScansToAverage>
<SurfaceParVoltageAdded>1</SurfaceParVoltageAdded>
<ScanTimeAdded>0</ScanTimeAdded>
<NmeaPositionDataAdded>1</NmeaPositionDataAdded>
<NmeaDepthDataAdded>0</NmeaDepthDataAdded>
<NmeaTimeAdded>0</NmeaTimeAdded>
<NmeaDeviceConnectedToPC>0</NmeaDeviceConnectedToPC>
<SensorArray Size="15" >
 <Sensor index="0" SensorID="55" >
  <TemperatureSensor SensorID="55" >
   <SerialNumber>5391</SerialNumber>
   <CalibrationDate>2016/02/05</CalibrationDate>
   <UseG_J>1</UseG_J>
   <A>0.00000000e+000</A>
   <B>0.00000000e+000</B>
   <C>0.00000000e+000</C>
   <D>0.00000000e+000</D>
   <F0_Old>0.000</F0_Old>
   <G>4.33123701e-003</G>
   <H>6.25994421e-004</H>
   <I>1.90784268e-005</I>
   <J>1.33201844e-006</J>
   <F0>1000.000</F0>
   <Slope>1.00000000</Slope>
   <Offset>0.0000</Offset>
  </TemperatureSensor>
 </Sensor>
 <Sensor index="1" SensorID="3" >
  <ConductivitySensor SensorID="3" >
   <SerialNumber>3718</SerialNumber>
   <CalibrationDate>2016/02/11</CalibrationDate>
   <UseG_J>1</UseG_J>
   <!-- Cell const and series R are applicable only for wide range sensors. -->
   <SeriesR>0.0000</SeriesR>
   <CellConst>2000.0000</CellConst>
   <ConductivityType>0</ConductivityType>
   <Coefficients equation="0" >
    <A>0.00000000e+000</A>
    <B>0.00000000e+000</B>
    <C>0.00000000e+000</C>
    <D>0.00000000e+000</D>
    <M>0.0</M>
    <CPcor>-9.57000000e-008</CPcor>
   </Coefficients>
   <Coefficients equation="1" >
    <G>-1.00296939e+001</G>
    <H>1.33944566e+000</H>
    <I>-8.71815224e-004</I>
```

```
        <J>1.31110285e-004</J>
        <CPcor>-9.57000000e-008</CPcor>
        <CTcor>3.2500e-006</CTcor>
        <!-- WBOTC not applicable unless ConductivityType = 1. -->
        <WBOTC>0.00000000e+000</WBOTC>
      </Coefficients>
      <Slope>1.00000000</Slope>
      <Offset>0.00000</Offset>
    </ConductivitySensor>
  </Sensor>
  <Sensor index="2" SensorID="45" >
    <PressureSensor SensorID="45" >
      <SerialNumber>1023</SerialNumber>
      <CalibrationDate>2016/02/17</CalibrationDate>
      <C1>-4.979972e+004</C1>
      <C2>7.716754e-001</C2>
      <C3>1.594560e-002</C3>
      <D1>3.855600e-002</D1>
      <D2>0.000000e+000</D2>
      <T1>3.000011e+001</T1>
      <T2>-5.335740e-005</T2>
      <T3>4.057330e-006</T3>
      <T4>3.751370e-009</T4>
      <Slope>1.00008000</Slope>
      <Offset>-1.75240</Offset>
      <T5>0.000000e+000</T5>
      <AD590M>1.282500e-002</AD590M>
      <AD590B>-9.474780e+000</AD590B>
    </PressureSensor>
  </Sensor>
  <Sensor index="3" SensorID="55" >
    <TemperatureSensor SensorID="55" >
      <SerialNumber>5425</SerialNumber>
      <CalibrationDate>2011/04/17</CalibrationDate>
      <UseG_J>1</UseG_J>
      <A>0.00000000e+000</A>
      <B>0.00000000e+000</B>
      <C>0.00000000e+000</C>
      <D>0.00000000e+000</D>
      <F0_Old>0.000</F0_Old>
      <G>4.32788459e-003</G>
      <H>6.26109022e-004</H>
      <I>1.92672295e-005</I>
      <J>1.40181153e-006</J>
      <F0>1000.000</F0>
      <Slope>1.00000000</Slope>
      <Offset>0.0000</Offset>
    </TemperatureSensor>
  </Sensor>
```

```
<Sensor index="4" SensorID="3" >
 <ConductivitySensor SensorID="3" >
  <SerialNumber>3907</SerialNumber>
  <CalibrationDate>2011/04/28</CalibrationDate>
  <UseG_J>1</UseG_J>
  <!-- Cell const and series R are applicable only for wide range sensors. -->
  <SeriesR>0.0000</SeriesR>
  <CellConst>2000.0000</CellConst>
  <ConductivityType>0</ConductivityType>
  <Coefficients equation="0" >
   <A>0.00000000e+000</A>
   <B>0.00000000e+000</B>
   <C>0.00000000e+000</C>
   <D>0.00000000e+000</D>
   <M>0.0</M>
   <CPcor>-9.57000000e-008</CPcor>
  </Coefficients>
  <Coefficients equation="1" >
   <G>-1.01219194e+001</G>
   <H>1.38857734e+000</H>
   <I>3.33913113e-004</I>
   <J>5.04149858e-005</J>
   <CPcor>-9.57000000e-008</CPcor>
   <CTcor>3.2500e-006</CTcor>
   <!-- WBOTC not applicable unless ConductivityType = 1. -->
   <WBOTC>0.00000000e+000</WBOTC>
  </Coefficients>
  <Slope>1.00000000</Slope>
  <Offset>0.00000</Offset>
 </ConductivitySensor>
</Sensor>
<Sensor index="5" SensorID="71" >
 <WET_LabsCStar SensorID="71" >
  <SerialNumber>1419</SerialNumber>
  <CalibrationDate>2011/04/15</CalibrationDate>
  <M>21.7274</M>
  <B>-0.0521</B>
  <PathLength>0.250</PathLength>
 </WET_LabsCStar>
</Sensor>
<Sensor index="6" SensorID="27" >
 <NotInUse SensorID="27" >
  <SerialNumber></SerialNumber>
  <CalibrationDate></CalibrationDate>
  <OutputType>2</OutputType>
  <Free>1</Free>
 </NotInUse>
</Sensor>
<Sensor index="7" SensorID="38" >
```

```
  <OxygenSensor SensorID="38" >
    <SerialNumber>1278</SerialNumber>
    <CalibrationDate>12-Apr-16</CalibrationDate>
    <Use2007Equation>1</Use2007Equation>
    <CalibrationCoefficients equation="0" >
      <!-- Coefficients for Owens-Millard equation. -->
      <Boc>0.0000</Boc>
      <Soc>0.0000e+000</Soc>
      <offset>0.0000</offset>
      <Pcor>0.00e+000</Pcor>
      <Tcor>0.0000</Tcor>
      <Tau>0.0</Tau>
    </CalibrationCoefficients>
    <CalibrationCoefficients equation="1" >
      <!-- Coefficients for Sea-Bird equation - SBE calibration in 2007 and later. -->
      <Soc>4.6548e-001</Soc>
      <offset>-0.5040</offset>
      <A>-3.6620e-003</A>
      <B> 1.7101e-004</B>
      <C>-2.6768e-006</C>
      <D0> 2.5826e+000</D0>
      <D1> 1.92634e-004</D1>
      <D2>-4.64803e-002</D2>
      <E> 3.6000e-002</E>
      <Tau20> 1.0600</Tau20>
      <H1>-3.3000e-002</H1>
      <H2> 5.0000e+003</H2>
      <H3> 1.4500e+003</H3>
    </CalibrationCoefficients>
  </OxygenSensor>
</Sensor>
<Sensor index="8" SensorID="27" >
  <NotInUse SensorID="27" >
    <SerialNumber></SerialNumber>
    <CalibrationDate></CalibrationDate>
    <OutputType>2</OutputType>
    <Free>1</Free>
  </NotInUse>
</Sensor>
<Sensor index="9" SensorID="33" >
  <OBS_SeapointTurbiditySensor SensorID="33" >
    <SerialNumber>12182</SerialNumber>
    <CalibrationDate>2011</CalibrationDate>
    <!-- The following is an array index, not the actual gain setting. -->
    <GainSetting>0</GainSetting>
    <ScaleFactor>1.000</ScaleFactor>
  </OBS_SeapointTurbiditySensor>
</Sensor>
<Sensor index="10" SensorID="11" >
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```xml
        <FluoroSeapointSensor SensorID="11" >
          <SerialNumber>3259</SerialNumber>
          <CalibrationDate>2011</CalibrationDate>
          <!-- The following is an array index, not the actual gain setting. -->
          <GainSetting>0</GainSetting>
          <Offset>0.000</Offset>
        </FluoroSeapointSensor>
      </Sensor>
      <Sensor index="11" SensorID="0" >
        <AltimeterSensor SensorID="0" >
          <SerialNumber>69894</SerialNumber>
          <CalibrationDate>2016</CalibrationDate>
          <ScaleFactor>15.000</ScaleFactor>
          <Offset>0.000</Offset>
        </AltimeterSensor>
      </Sensor>
      <Sensor index="12" SensorID="42" >
        <PAR_BiosphericalLicorChelseaSensor SensorID="42" >
          <SerialNumber>70364</SerialNumber>
          <CalibrationDate>2011/03/28</CalibrationDate>
          <M>1.00000000</M>
          <B>0.00000000</B>
          <CalibrationConstant>19881000000.00000000</CalibrationConstant>
          <Multiplier>1.00000000</Multiplier>
          <Offset>-0.05109377</Offset>
        </PAR_BiosphericalLicorChelseaSensor>
      </Sensor>
      <Sensor index="13" SensorID="27" >
        <NotInUse SensorID="27" >
          <SerialNumber></SerialNumber>
          <CalibrationDate></CalibrationDate>
          <OutputType>0</OutputType>
          <Free>0</Free>
        </NotInUse>
      </Sensor>
      <Sensor index="14" SensorID="51" >
        <SPAR_Sensor SensorID="51" >
          <SerialNumber>20519</SerialNumber>
          <CalibrationDate>2016/04</CalibrationDate>
          <ConversionFactor>1631.35600000</ConversionFactor>
          <RatioMultiplier>1.00000000</RatioMultiplier>
        </SPAR_Sensor>
      </Sensor>
    </SensorArray>
  </Instrument>
</SBE_InstrumentConfiguration>
```