



Belgica cruise 99/19 - Scientific report

OMEX II-II cruise (Leg B, La Coruña - La Coruña)

1. Participants

MUMM	Joan Backers Jean-Pierre Deblauwe Reinhilde Van den Brande
ULB	Bénédicte Bastin Lei Chou Michèle Loijens
ULg	Alberto Borges Claire Daemers Michel Frankignoulle (Chief Scientist)
VUB	Tungaraza Clavery
BODC	Mary Robjant Alison Fairclough
PML	Georgina Spyres
UAL	Pedro André Jesus Mendez Pedro Miguel Coutinho Victorino Borges Morais

2. Measured parameters & processes

2.1 Underway measurements (sailing)

MUMM: Salinity, temperature, fluorescence, ship track, meteo.

ULg: pH, dissolved oxygen & pCO₂ (each minute), chlorophyll and total alkalinity (discrete sampling).

2.2 Vertical profiles (stations)

MUMM: CTD (conductivity, temperature, backscatterance & dissolved oxygen), light penetration (Seacat).

ULB: Primary production (¹⁴C & ³²P), chlorophyll, nutrients, *in situ* pumping (sap).

ULg: pH, total alkalinity, dissolved oxygen

VUB: Uptake rate of NO₃, NH₄ & urea using ¹⁵N tracer technique.

BODC: Data management, CTD

PML: DOC, pigments

UAL: Bacteriology



3. Work overview

During the cruise, the following work has been carried out:

- CTD Casts (SBE09): 60 profiles
- Seacat (SBE19): 22 profiles
- Parameters: 328 samples
- Primary production: 10 stations, 56 measurements
- Bacteria: 8 Casts
- Purifier: 8 stations
- Sap: 20 samples
- Non-stop underway measurement

4. Detailed sequence of operations

- Time is expressed in GMT (LT-2)
- Stations details are provided in a joint Excel spreadsheet (BG9919.xls)

4th September:

- Departure from La Coruña at 09h00, sailing to station 48, underway measurements.

- Station 48

- Arrival at 15h52
- Depth: >2000m
- **CTD 991948A** (deep parameters cast) from 15h59 to 17h19 (-> 1724m)
Sampling at 1724, 1500, 1250, 1100, 1000, 900, 800, 600, 400, 300, 200, 150 m
- **CTD 991948B** (surface parameters cast) from 18h00 to 18h10 (-> 100m)
Sampling at 100, 90, 80, 70, 60, 50, 40, 30, 20, 5m
- Departure at 18h40, sailing to station 41, underway measurements.

- Station 41

- Arrival at 19h41
- Depth: 1700m
- **CTD 991941A** (no sampling) from 19h50 to 22h18 (-> 1740m)
Rem: problems with the cable when CTD is going up
- Departure at 22h25, sailing to station 40, underway measurements.

- Station 40

- Arrival at 23h10
- Depth: 860m



- **CTD 991940A** (no sampling) from 23h11 to 23h45 (-> 700m)
- Departure at 23h47, sailing to station 44, underway measurements.

5th September:

- **Station 44**

- Arrival 04h56
- Depth: 58m
- **CTD 991944A** (Primary production & parameters) from 05h36 to 05h45 (->50m)
Sampling at 1x50, 2x40, 2x30, 2x20, 5x5m
- **CTD 991944B** (bacteriology cast) from 06h22 to 06h31 (-> 40m)
Sampling at 3x40, 2x30, 2x20, 2x10, 3x5 m
- Seacat profiles at 06h39, 09h03 & 11h04 (respectively 21, 109 & 236 W/m²)
- Purifier from 04h58 to 11h07 (2224 l)
- Departure at 11h13, sailing to station 46 via Ria de Corcubion, underway measurements.

- **Station 46**

- Arrival at 15h50
- Depth: 207m
- **CTD 991946A** (surface parameters cast) from 16h05 to 16h23 (-> 190m)
Sampling at 190, 150, 100, 90, 80, 70, 60, 50, 40, 30, 20, 5m
- Departure at 16h52, sailing to station 39, underway measurements.

- **Station 39**

- Arrival at 17h49
- Depth: 163m
- **CTD 991939A** (no sampling) from 17h53 to 18h04 (-> 150m)
- Departure at 18h09, sailing to station 38, underway measurements.

- **Station 38**

- Arrival at 18h48
- Depth: 125m
- **CTD 991938A** (no sampling) from 18h50 to 18h58 (-> 116m)
- Departure at 19h01, sailing to station 31, underway measurements.

- **Station 31**

- Arrival at 19h59
- Depth: 130m
- **CTD 991931A** (surface parameters cast) from 20h03 to 20h17 (-> 120m)



Sampling at 120, 100, 90, 80, 70, 60, 50, 40, 30, 20, 5m

- Departure at 20h45, sailing to station 24, underway measurements.

- Station 24

- Arrival at 22h00
- Depth: 85m
- **CTD 991924A** (no sampling) from 22h03 to 22h12 (-> 80m)
- Departure at 22h14, sailing to station 25, underway measurements.

- Station 25

- Arrival at 22h40
- Depth: 86m
- **CTD 991925A** (no sampling) from 22h42 to 22h52 (-> 80m)
- Departure at 22h55, sailing to station 26, underway measurements.

- Station 26

- Arrival at 23h50
- Depth: >1000m
- **CTD 991926A** (no sampling) from 23h55 to 00h19 (-> 800m)
- Departure at 00h21, sailing to station 45, underway measurements.

6th September:

- Station 45

- Arrival 05h55
- Depth: 138m
- **CTD 991945A** (Primary production) from 06h03 to 06h14 (-> 80m)
Sampling at 1x80, 1x60, 4x45, 1x30, 1x20, 4x5m
- **CTD 991944B** (parameters cast) from 06h44 to 06h59 (-> 120m)
Sampling at 120, 100, 90, 80, 70, 60, 50, 40, 30, 20, 5m
- **CTD 991944C** (bacteriology cast) from 07h28 to 07h38 (-> 80m)
Sampling at 1x80, 1x60, 1x45, 1x30, 1x20, 3x5m
- Seacat profiles at 07h41, 09h50 & 11h57 (respectively 154, 109 & 728 W/m²)
- Purifier from 05h55 to 12h05 (2264 l)
- Departure at 12h05, sailing to station 34, underway measurements.

- Station 34

- Arrival at 14h30
- Depth: >1400m
- **CTD 991934A** (surface parameters cast) from 14h38 to 14h53 (-> 100m)



Sampling at 100, 90, 80, 70, 60, 50, 40, 30, 20, 2x5m

- **CTD 991934B** (deep parameters cast) from 15h59 to 17h19 (-> 1450m)
Sampling at 1450, 1250, 1100, 1000, 900, 800, 600, 400, 300, 200, 150 m
- Departure at 17h55, sailing to station 32, underway measurements.

- Station 32

- Arrival at 18h47
- Depth: >208m
- **CTD 991932A** (surface parameters cast) from 18h50 to 19h07 (-> 195m)
Sampling at 195, 150, 100, 90, 80, 70, 60, 50, 40, 30, 20, 5m
- Departure at 17h55, sailing to station 32, underway measurements.

- Station 27

- Arrival at 20h40
- Depth: >2000m
- **CTD 991927A** (no sampling) from 20h48 to 22h00 (-> 1500m)
- Departure at 22h06, sailing to station 29, underway measurements.

7th September:

- Station 29

- Arrival 06h00
- Depth: 83m
- **CTD 991945A** (Primary production) from 06h06 to 06h19 (-> 75m)
Sampling at 1x60, 1x40, 4x30, 1x20, 4x5m
- **CTD 991944B** (parameters cast) from 06h47 to 06h59 (-> 80m)
Sampling at 80, 70, 60, 50, 40, 30, 20, 5m
- **CTD 991944C** (bacteriology cast) from 07h26 to 07h36 (-> 70m)
Sampling at 4x70, 1x60, 1x40, 1x30, 1x20, 4x5m
- Seacat profiles at 06h38, 08h02, 09h55 & 11h57 (respectively 16, 250, 584 & 752 W/m²)
- Purifier from 06h00 to 12h04 (2002 l)
- Departure at 12h05, sailing to station 35, underway measurements.

- Station 35

- Arrival at 14h58
- Depth: >2000m
- **CTD 991935A** (surface parameters cast) from 15h07 to 15h18 (-> 150m)
Sampling at 150, 100, 90, 80, 70, 60, 50, 40, 30, 20, 5m



- **CTD 991935B** (deep parameters cast) from 16h30 to 18h24 (-> 1710m)
Sampling at 1710, 1500, 1250, 1100, 1000, 900, 800, 600, 400, 300 m
(Niskin 200m not closed)
- Departure at 18h35, sailing to station 36, underway measurements.

- Station 36

- Arrival at 19h21
- Depth: >2000m
- **CTD 991934A** (surface parameters cast) from 19h31 to 19h42 (-> 150m)
Sampling at 150, 100, 90, 80, 70, 60, 50, 40, 30, 20, 5m
- **CTD 991934B** (deep parameters cast) from 20h05 to 21h45 (-> 1743m)
Sampling at 2x1743, 1500, 1250, 1100, 1000, 900, 800, 600, 400, 300, 200m
- Departure at 22h14, sailing to station 30, underway measurements.

8th September:

- Station 30

- Arrival 03h01
- Depth: 100m
- **CTD 991930A** (Primary production) from 06h00 to 06h13 (-> 80m)
Sampling at 1x80, 1x60, 4x40, 1x30, 1x20, 4x5m
- **CTD 991930B** (parameters cast) from 06h36 to 06h49 (-> 90m)
Sampling at 90, 80, 70, 60, 50, 40, 30, 20, 5m
- **CTD 991930C** (bacteriology cast) from 07h26 to 07h36 (-> 80m)
Sampling at 1x80, 1x60, 1x40, 1x30, 1x20, 3x5m
- Seacat profiles at 07h02, 08h02 & 09h55 (respectively 42, 263 & 596 W/m²)
- *In situ* pumping at 80, 60, 40, 20 & 5m
- Purifier from 05h10 to 10h40 (2298 l)
- Departure at 10h49, sailing to station 15, underway measurements.

- Station 15

- Arrival at 14h20
- Depth: >2200m
- **CTD 991915A** (surface parameters cast) from 14h21 to 14h34 (-> 100m)
Sampling at 100, 90, 80, 70, 60, 50, 40, 30, 20, 5m
- **CTD 991915B** (deep parameters cast) from 15h56 to 17h26 (-> 1700m)
Sampling at 1700, 1500, 1250, 1100, 1000, 900, 800, 600, 400, 300, 200, 150m
- Departure at 17h35, sailing to station 21, underway measurements.

**- Station 21**

- Arrival at 18h47
- Depth: 1480m
- **CTD 991921A** (no sampling) from 18h48 to 21h23 (-> 1400m)
- Departure at 21h35, sailing to station 19, underway measurements.

- Station 19

- Arrival at 23h21
- Depth: 157m
- **CTD 991919A** (no sampling) from 23h23 to 23h30 (-> 140m)
- Departure at 23h35, sailing to station 11, underway measurements.

9th September:**- Station 11**

- Arrival 04h45
- Depth: 94m
- **CTD 991911A** (Primary production) from 06h00 to 06h09 (-> 90m)
Sampling at 1x80, 1x60, 4x40, 1x30, 1x20, 4x5m
- **CTD 991911B** (parameters cast) from 06h33 to 06h43 (-> 80m)
Sampling at 80, 70, 60, 50, 40, 30, 20, 5m
- **CTD 991911C** (bacteriology cast) from 07h06 to 07h15 (-> 80m)
Sampling at 2x80, 1x60, 1x40, 1x30, 1x20, 2x5m
- Seacat profiles at 06h49, 08h09, 09h57 & 11h58 (respectively 64, 395, 635 & 515 W/m²)
- Purifier from 05h42 to 12h00 (1848 l)
Rem: stop around 09h00 (fuses)
- Departure at 12h08, sailing to station 13, underway measurements.

- Station 13

- Arrival at 13h25
- Depth: 223m
- **CTD 991913A** (surface parameters cast) from 13h39 to 13h57 (-> 200m)
Sampling at 200, 150, 100, 90, 80, 70, 60, 50, 40, 30, 20, 5m
- Departure at 14h10, sailing to station 16, underway measurements.

- Station 16

- Arrival at 17h00
- Depth: >2000m
- **CTD 991916A** (surface parameters cast) from 17h06 to 17h17 (-> 100m)



- Sampling at 100, 90, 80, 70, 60, 50, 40, 30, 20, 5m
- **CTD 991916B** (deep parameters cast) from 17h42 to 19h30 (-> 1700m)
Sampling at 1700, 1500, 1250, 1100, 1000, 900, 800, 600, 400, 300, 200, 150m
 - Departure at 19h50, sailing to station 20, underway measurements.

- Station 20

- Arrival at 22h35
- Depth: >2000m
- **CTD 991920A** (no sampling) from 22h40 to 23h11 (-> 640m)
- Departure at 23h13, sailing to station 33, underway measurements.

10th September:

- Station 33

- Arrival 02h35
- Depth: >1000m
- **CTD 991933A** (Primary production) from 05h59 to 06h09 (-> 100m)
Sampling at 1x80, 1x60, 1x40, 1x30, 4x20, 4x5m
- **CTD 991933B** (surface parameters cast) from 06h38 to 06h49 (-> 100m)
Sampling at 100, 90, 80, 70, 60, 50, 40, 30, 20, 5m
- **CTD 991933C** (deep parameters cast) from 07h12 to 08h07 (-> 1043m)
Sampling at 1000, 900, 800, 600, 400, 300, 200, 150m
- Surface Niskin (bacterio) at 08h48
- Seacat profiles at 06h54, 08h12, 09h58, 11h55 & 13h58 (respectively 27, 109, 581, 353 & 328 W/m²)
- *In situ* pumping at 500, 200, 100, 80, 60, 40, 20 & 5m
- Purifier from 02h53 to 15h31 (4907 l)
- Departure at 15h32, sailing to station 49, underway measurements.

- Station 49

- Arrival 02h35
- Depth: >2000m
- **CTD 991930A** (surface parameters cast) from 18h43 to 18h54 (-> 100m)
Sampling at 100, 90, 80, 70, 60, 50, 40, 30, 20, 5m
- **CTD 991930B** (deep parameters cast) from 19h13 to 20h05 (-> 1000m)
Sampling at 1000, 900, 800, 600, 400, 300, 200, 150m
- Departure at 20h56, sailing to station 44bis, underway measurements.

**11th September:****- Station 44bis**

- Arrival 05h56
- Depth: 53m
- **CTD 991944C** (Primary production & parameters) from 06h05 to 06h14 (-> 40m)
Sampling at 2x40, 2x30, 4x20, 4x5m
- Seacat profile at 07h01 (109 W/m²)
- Departure at 07h19, sailing to La Coruña, underway measurements.

14th September:

Departure from La Coruña at 07h00, underway measurements.

- Station 00 (43°12N, 09°15W, Chla max from remote sensing)

- Arrival 11h11
- Depth: 83m
- **CTD 991900A** (parameters) from 11h14 to 11h25 (-> 80m)
Sampling at 80, 70, 60, 50, 40, 30, 20 & 5m
- Departure at 11h44, sailing to station 44ter, underway measurements.

- Station 44ter

- Arrival 13h09
- Depth: 50m
- **CTD 991944D** (parameters) from 13h12 to 13h21 (-> 40m)
Sampling at 40, 30, 20 & 5m
- Departure at 13h46, sailing to station 42, underway measurements.

- Station 42

- Arrival at 16h40
- Depth: >2000m
- **CTD 991942A** (no sampling) from 16h51 to 18h15 (-> 1700m)
- Departure at 18h55, sailing to station 43, underway measurements.

- Station 43

- Arrival at 19h36
- Depth: >2000m
- **CTD 991943A** (no sampling) from 19h45 to 21h10 (-> 1700m)
- Departure at 21h35, sailing to station 37, underway measurements.

**15th September:****- Station 37**

- Arrival 05h55
- Depth: >2000m
- **CTD 991937A** (Primary production) from 06h02 to 06h15 (-> 100m)
Sampling at 1x80, 1x60, 4x40, 1x30, x20, 4x5m
- **CTD 991937B** (surface parameters cast) from 06h42 to 06h53 (-> 150m)
Sampling at 150, 100, 90, 80, 70, 60, 50, 40, 30, 20, 2x5m
- **CTD 991937C** (deep parameters cast) from 07h30 to 09h15 (-> 1716m)
Sampling at 2x1716, 1500, 1250, 1100, 1000, 900, 800, 600, 400, 300, 200m
- Seacat profiles at 09h20 & 09h53 (respectively 514 & 563 W/m²)
- Departure at 12h05, sailing to station 36bis, underway measurements.

- Station 36bis

- Arrival 11h37
- Depth: >2000m
- *In situ* pumping at 200, 100, 80, 60, 40, 20 & 5m
- Purifier from 11h39 to 21h05 (13569 l)
- Departure at 21h30, sailing to station 12, underway measurements.

16th September:**- Station 12**

- Arrival 05h40
- Depth: 153m
- **CTD 991912A** (Primary production) from 06h02 to 06h13 (-> 100m)
Sampling at 1x80, 1x60, 1x40, 3x30, 1x20, 5x5m
- **CTD 991912B** (surface parameters cast) from 06h43 to 06h54 (-> 125m)
Sampling at 125, 100, 90, 80, 70, 60, 50, 40, 30, 20, 5m
- Surface Niskin (bacterio) at 07h05
- Seacat profiles at 06h58, 08h04, 09h55 & 12h01 (respectively 96, 91, 76 & 130 W/m²)
- Purifier from 05h54 to 12h03 (2014 l)
- Departure at 12h05, sailing to Ria de Vigo

**- Ria de Vigo**

- 4 surface water samples (seawater circuit) for the determination of DIC, oxygen, DOC, pigments & nutrients)

V1 = 42°09'42"N 08°54'11"W

V2 = 42°11'16"N 08°51'38"W

V3 = 42°12'59"N 08°49'20"W

V3 = 42°14'11"N 08°46'36"W

- sailing to the South along the coast, and then to station 18, underway measurements

- Station 18

- Arrival at 21h20

- Depth: 150m

- **CTD 991918A** (no sampling) from 21h15 to 21h32 (-> 130m)

- Departure at 21h35, sailing to station 14, underway measurements.

17th September:**- Station 14**

- Arrival 05h52

- Depth: 1700m

- **CTD 991914A** (Primary production) from 06h02 to 06h14 (-> 100m)

Sampling at 1x80, 3x50, 1x40, 1x30, 1x20, 5x5m

- **CTD 991914B** (surface parameters cast) from 06h36 to 06h51 (-> 150m)

Sampling at 150, 100, 90, 80, 70, 60, 50, 40, 30, 20, 2x5m

- **CTD 991914C** (deep parameters cast) from 07h21 to 08h45 (-> 1500m)

Sampling at 3x1500, 1250, 1100, 1000, 900, 800, 600, 400, 300, 200m

Rem: Niskin at 800m not closed

- Seacat profiles at 06h56, 08h54, 09h55 & 12h00 (respectively 15, 210, 159, & 740 W/m²)

- Purifier from 05h52 to 12h01 (2651 l)

- Departure at 12h10, sailing to station 22, underway measurements.

- Station 22

- Arrival at 13h48

- Depth: >2000m

- **CTD 991922A** (no sampling) from 13h55 to 15h14 (-> 1300m)

- Departure at 15h17, sailing to La Coruña, underway measurements.



5. Specific remarks

Many thanks to both *Belgica* crew and MUMM for the help provided at work.

Done in Liège, 24th September 1999

Michel Frankignoulle