

RV BELGICA CRUISE 2022/22 – CRUISE REPORT



| | |
|--------------|---|
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Geology: 15/09/2022 - 25/09/2022

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1. CRUISE DETAILS

| | | |
|----|---|--|
| 1. | Cruise number | 2022/22 |
| 2. | Date/time Zeebrugge TD Zeebrugge TA | 15/09/2022 at 09h30 (UTC; 11h30 local time) 25/09/2022 at 08h00 (UTC; 10h00 local time) |
| 3. | Chief Scientist Participating institutes | Dr. Tine Missiaen VLIZ, UGent, TNO |
| 4. | Area of interest | Southern North Sea |

2. LIST OF PARTICIPANTS

| Institute | NAME | | 15/09 - 25/09/22 |
|---------------------------------|-------------------------------|--|------------------|
| VLIZ | Tine Missiaen | | X |
| | Ruth Plets | | X |
| | Wim Versteeg | | X |
| | Thomas Mestdagh | | X |
| | Filipe Barradas | | X |
| | Victor Cartelle | | X |
| | Despina Kyriakoudi | | X |
| | Jan Vermaut | | 15/09/22 |
| | Andre Cattrijsse ¹ | | 15/09/22 |
| UGent - RCMG | Morgan Vervoort | | X |
| TNO / Utrecht University | Irene Waajen | | X |
| | | | |
| | | | |
| <i>Total participants:</i> | | | 9 (+2 first day) |



From left to right: Irene, Wim, Filipe, Victor, Ruth, Tine, Thomas, Despina, Morgan

3. SCIENTIFIC OBJECTIVES

In 2018 and 2019 seismic surveys were conducted onboard RV *Belgica* in the wider Brown Bank area, aiming to map the late Quaternary palaeolandscape and link this to possible human presence. These surveys generated a unique dataset of unprecedented quality, and targeted sampling in 2019 resulted in the discovery of prehistoric (peat) landsurfaces, as well as several pieces of wood and flint. Owing to the vastness of the study area, further seismic/geophysical and ground truthing investigations are necessary. The aims of the *Belgica* survey 2022 are to (1) fill data gaps for geomorphologic / palaeogeographic studies, (2) to investigate the link with the drowned 'Doggerland', (3) to conduct detailed seismic investigations and seafloor sampling in well-chosen sub-areas for archaeological studies, and (4) construct a regional (trans-boundary) stratigraphy. As well as the sampling and surveying in the wider Brown Bank area, a first reconnaissance seismic survey will be conducted for the WALDO project (Survey 2022/30).

4. OPERATIONAL COURSE

All times are given in UTC. All coordinates in WGS84.

Thursday 15/09/2022

Weather:

AM: relatively calm (no white caps), 0.5-1m waves, 4 Bft, Wind from NW

PM: wind picking up, 6Bft, waves up to 2m

| | |
|-------------|--|
| 06h30-08h30 | Embarkation of equipment and personnel |
| 08h30-9h30 | Preparation vibrocorer on deck |
| 09h30 | Transit to vibrocore stations in 'Het Scheur' |
| 11h32 | Arrive at first station |
| 11h32-14h20 | Acquisition 4 vibrocores |
| 14h20 | End of coring |
| 15h35 | Recovery Tripod off Zeebrugge |
| 16h00 | Transfer of Jan Vermaut and Andre Cattrijsse to harbour with RIB |
| 16h30 | Start transit to Brown Bank area |
| 17h00 | TOPAS acquisition started |

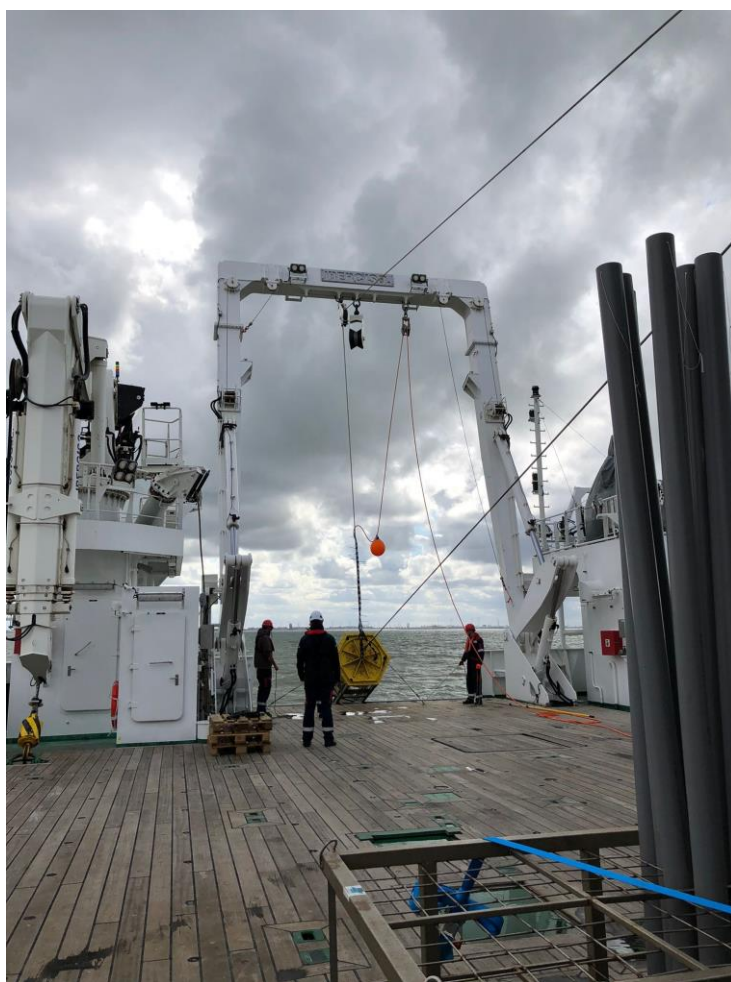


Figure 1: Deployment of vibrocorer

Friday 16/09/2022

AM: downpours, 5-7Bft, wind from NW, waves c. 2m increasing up to 3m, relatively clear

PM: wind picking up (up to 8Bft), waves increasing in height to 3m

06h00 Arrive at the wrong grid (VC29/30 instead of the Axial Channel) – transit to the correct grid @10 knots (TOPAS continues to be recorded; data quality is OK)

07h39 Start with line AX22 (S->N) + MBES (EM2040) started – started at 4kn; bad data quality; requested 6kn, but data gaps remain. Going into the waves causes vibrations along the underside of the hull, leading to loss in signal of TOPAS and MBES.

07h56 Abandon S->N line and try E->W lines

08h24 Start W-E lines AX01->AX04; W->E lines slightly better than E->W lines

12h31 Weather becoming too bad; waves >3m leading to loss in data signal; stop surveying
Transit to shelter area off Ipswich

Saturday 17/09/2022

5Bft, wind from NW, waves c. 1-1.5m (some white caps), clear

Sheltering off Ipswich

Sunday 18/09/2022

5-6Bft, wind from NW, waves c. 1-1.5m (some white caps), clear

Sheltering off Ipswich

Monday 19/09/2022

5Bft, wind from NW, waves c. 2-2.5m (white caps), clear and sunny with some clouds

06h00 Departure towards the Axial Channel

09h41 Arrive at start line AX07 – start in W->E direction with TOPAS and MBES

Lines: AX07, AX09, AX12, AX14, AX16, AX18, AX19, AX21

23h38 Start WALDO lines

Continue lines at 6 knots

Note: W->E lines and E->W lines have good data quality; when moving from S->N there is often a loss in signal in the data (due to vibration in the ship caused by the pitch)

Note: Queen Elizabeth II funeral

Tuesday 20/09/2022

5Bft, wind from NW, waves c. 2m (some white caps), clear and sunny with some clouds; becoming fairer towards the evening: 4-3Bft, wave height dropping to c.1m, wind shifting from the N

00h00 W01-W08

W09: stopped half way

18:46 Start transit to the south, continue TOPAS survey (parallel to planned W17)

Note: Some of the lines had to be cut short or changed compared to the planning because of the presence of oil and gas platforms

Wednesday 21/09/2022

Fair, calm, clear; becoming hazy towards the afternoon; 0.5-1m waves

AM: 1Bft with wind from the NW; warm

PM: wind turning from the SSW, picking up to 3Bft, becoming cooler towards the evening

05h30 Arrive at the Axial channel coring site

06h03 Start first coring site

Sites cored: AX01->AX12

Note: many of the cores failed, either returning empty, problems with the core catcher, or with extracting the cores – see more details in the table under section 6.2.

Note: during transit to coring transects, TOPAS data were recorded

15h45 End of coring; cores stored in the cold store and prepare the deck for deployment multichannel Sparker

17h42 Sparker and multichannel streamer in water

17h50 Start Sparker & TOPAS lines AX15; some interference of Sparker visible on TOPAS; surveying at 3.5 knots

19h06 Start MBES

Lines AX15, AX17



Figure 2: Retrieval vibrocorer on deck.

Thursday 22/09/2022

Fair, calm, clear; 0.5-1m waves
3-4Bft with wind from the SW

Continue Sparker, TOPAS and MBES @3.5 knots

AM: lines AX18b, AX20, transit lines between core sites

09h17 Arrive at the northern core sites of the Axial Channel

09h33 End of the seismic survey

09h47 Sparker and streamer back on deck

10h21 Start coring, site AX13

Sites cored: AX13->AX16

12h56 End of vibrocoring

13h00 Start TOPAS and MBES @8kn to the start of line AX02

15h15 Sparker and multichannel streamer in the water

15h20 Start survey (TOPAS, MBES, Sparker) Axial Channel, sailing northwards starting with AX02

Lines AX02, AX04, AX05, AX06, AX08, AX10

Friday 23/09/2022

Misty, 0.5-1m waves; rain in the morning, becoming sunny in the afternoon
3-4Bft with wind from the NNE

Lines AX11, AX13

06h25 End of Sparker survey

06h30 Sparker out of the water

06h35 Transit to W09 @ full speed (TOPAS and MBES recorded)

10h50 Start WALDO lines again @ 6knots with TOPAS and MBES

Lines W09, W10, W11, W12, W13

Throughout the day, the vibrocores were split in the fish lab under red light



Figure 3: Splitting and describing of cores onboard (fish lab)

Saturday 24/09/2022

AM: Grey, rainy, 3-4Bft, wind from NNE, c. 1m waves; becoming sunnier by 7.00

PM: wind and waves picking up, 5Bft with wind from NE, 1.4m waves

Continued WALDO lines

Lines W14, W15, W16, W17, W18

Throughout the day, the vibrocores were split in the fish lab under red light

Sunday 25/09/2022

00h41 End WALDO lines survey

Transit to Zeebrugge

08h00 Arrival at Zeebrugge – demobilization of all material finished around 12h30

- End of survey 2022/22 -

5. TRACK PLOT

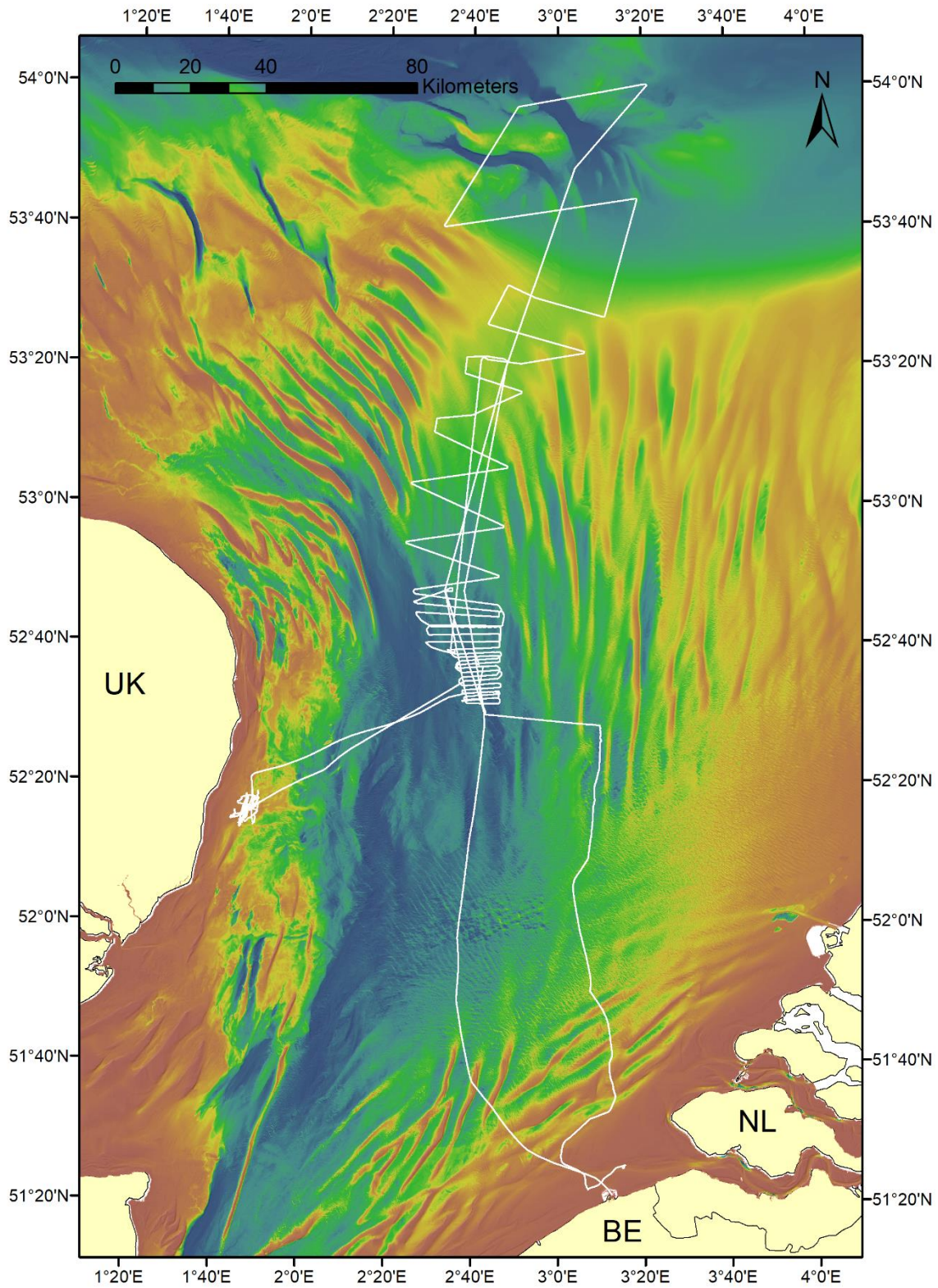


Figure 4: Track plot of survey 2022/22

6. MEASUREMENTS AND SAMPLING

6.1. Data acquisition - Settings

TOPAS PS18 acquisition settings

| Parameter | Value | Notes |
|--------------------|--------|--|
| Ping interval | 0.2 s | |
| Pulse type | Ricker | |
| Frequency | 4 kHz | |
| Sampling frequency | 64 kHz | |
| Trace length | 100 ms | Increased to 130 ms from 24/09/22 04:38 UTC (second part of W14) onwards |
| Delay | 10 ms | |

Sparker acquisition settings

Instrumentation: GSO360 sparker (using 360 tips) + SIG 24-channel streamer

Offsets: sparker 25 m behind aft & 4 m to port from centre, streamer CH1 30 m behind aft & 4 m to starboard from centre

| Parameter | Value | Notes |
|--------------------|--------|-------|
| Shot interval | 0.5 s | |
| Energy | 800 J | High |
| Sampling frequency | 8 kHz | |
| Recording length | 200 ms | |
| Recording delay | 0 ms | |
| Streamer gain | 4 dB | |





Figure 5: Setup and deployment of Sparker system

Multibeam EM2040

At the end of the survey, we noticed that the acquisition settings had been changed. We had originally set these settings to be the same as we used in the past onboard the RV Simon Stevin; this to allow comparison of data (especially backscatter). We assume the data technician onboard must have changed these at some point to more standard settings – we do not know exactly when these were changed.

| Parameter | Value | Settings at start of survey |
|-----------------------------|--------------|------------------------------------|
| Sector coverage | 60-10-10-60 | 70-10-10-70 |
| Max coverage | 500 | 500 |
| Angular coverage mode | Manual | Auto |
| Sector mode | Normal | Normal |
| Beam spacing | HD Eqdst | HD Eqdst |
| Force depth | 53m | 1 |
| Min depth | 5m | |
| Max depth | 100m | |
| Ping mode | 300kHz | 400kHz |
| Pulse Type | Medium CW | Short CW |
| Detector mode | Normal | Normal |
| Max ping rate | 50 Hz | 50 Hz |
| Pitch stabilization | | X |
| Heading Filter | Medium | Weak |
| External trigger | X | |
| Spike Filter strength | Off | Medium |
| Range gate | Normal | Normal |
| Phase ramp | Normal | Normal |
| Penetration filter strength | Off | Off |
| Slope | x | x |
| Backscatter adjustment | 10 degrees | 10 |

6.2. First results

Examples of TOPAS data

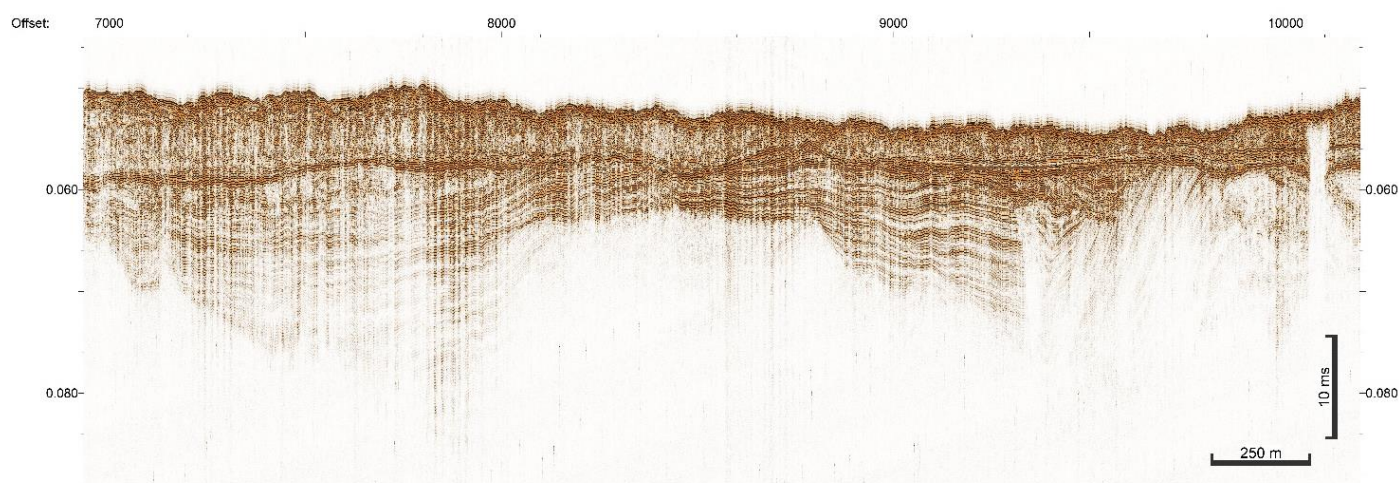


Figure 6: Part of line AX19, acquired with the TOPAS PS18. The example shows online processed data (only bandpass filter applied). Orientation of the line is west to east. Vertical scale in milliseconds two-way travel time.

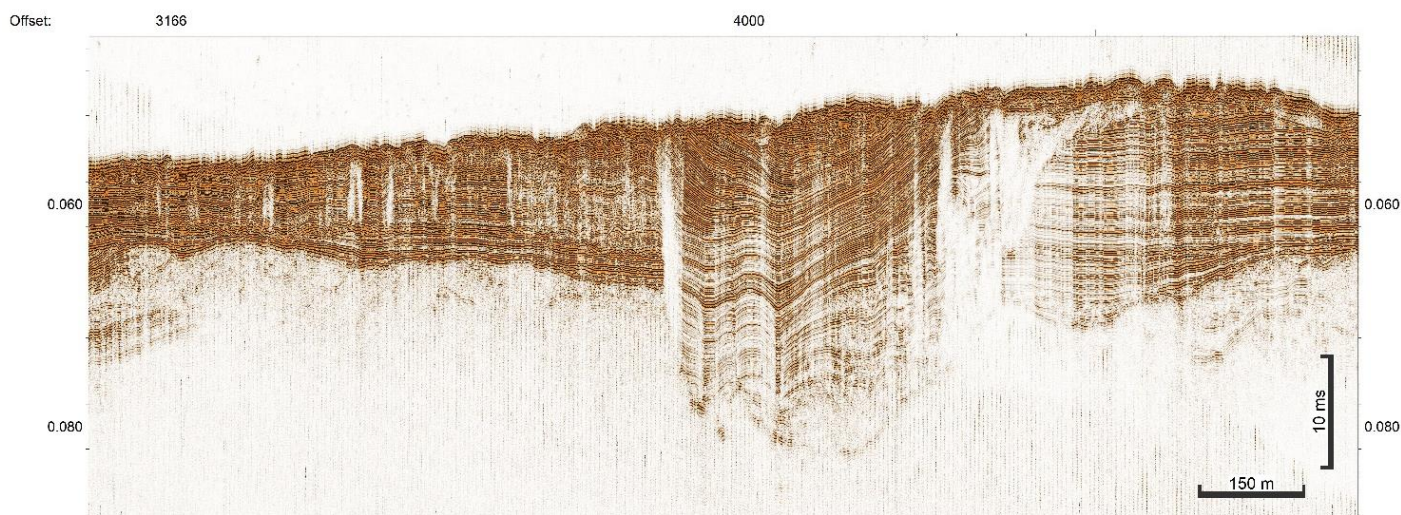


Figure 7: Part of line AX13, acquired with the TOPAS PS18. The example shows online processed data (only bandpass filter applied). Orientation of the line is west to east. Vertical scale in milliseconds two-way travel time.

Example of Sparker data

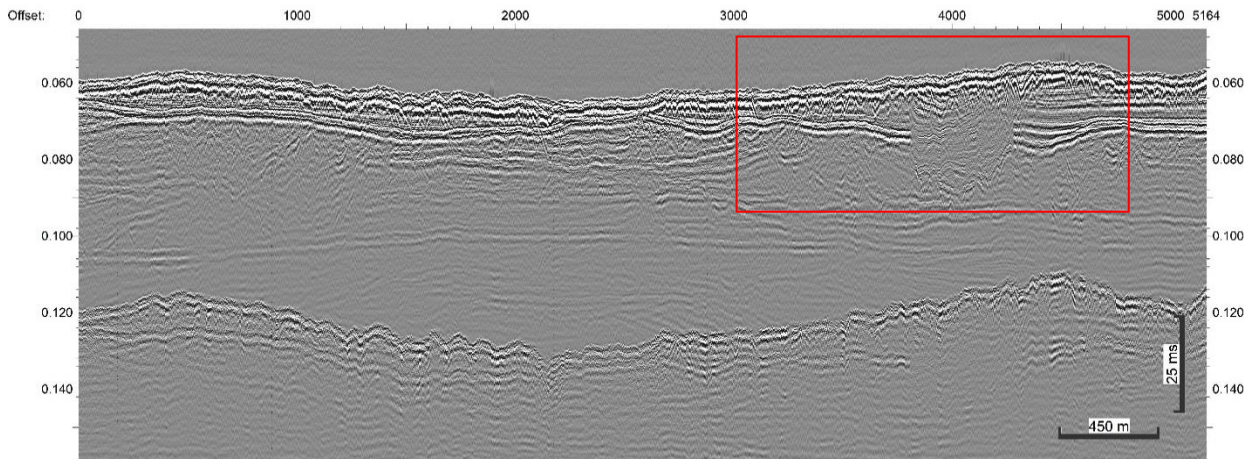


Figure 8: Part of line AX13, acquired with the GSO360 sparker and 24-channel streamer. The example shows raw pre-stack data recorded in Channel 3. The red box corresponds to the location of the TOPAS example shown in Figure 7. Orientation of the line is west to east. Vertical scale in milliseconds two-way travel time.

Example of core data

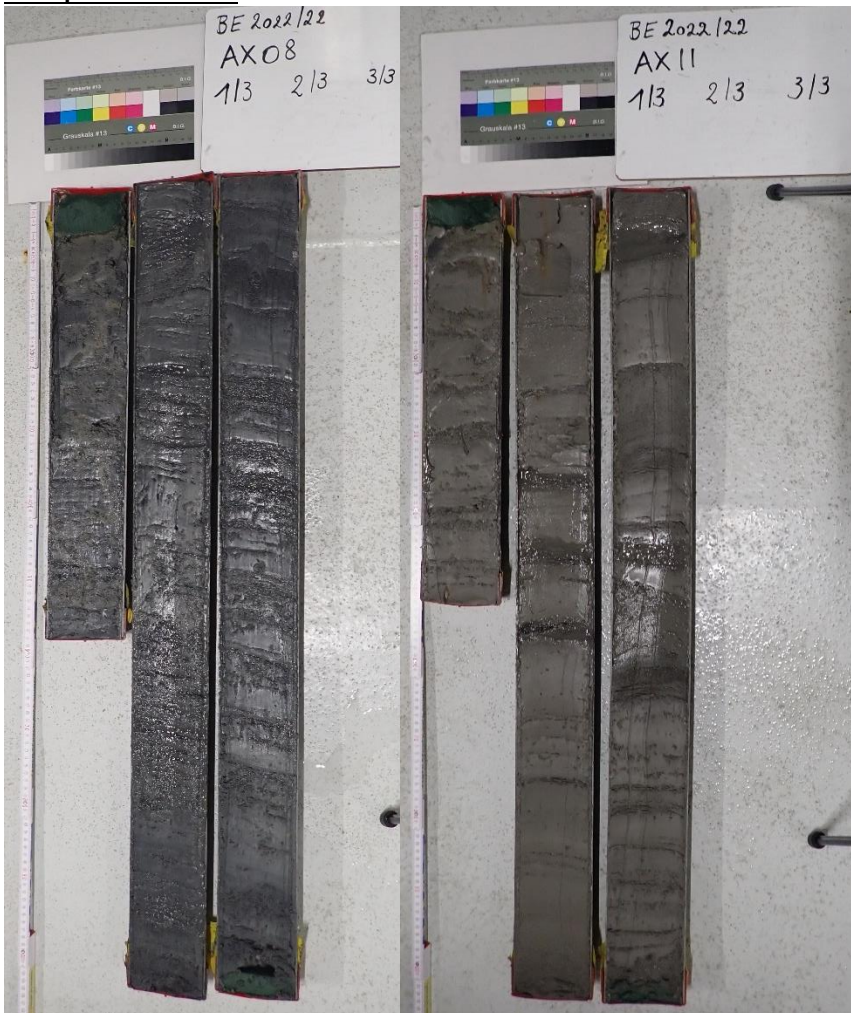


Figure 9: Example of two representative cores. On the left, a core through the 'Brown Bank Formation'; on the right, a core through the channel sediment targeted with the TOPAS in the Axial Channel area.

Vibrocoring

Below the table of cores taken on a daily basis. The positions are (i) those given to the Captain, (ii) those recorded from the central GPS antenna (centre of gravity), (iii) corrected for layback. The latter need to be corrected for layback (based on heading) for the correct position.

Thursday 15/09/2022

| Core name | Time | (i) Lat (N) | (i) Long (E) | (ii) Lat (N) | (ii) Long (E) | (iii) Lat (N) | (iii) Long (E) | Number of sections | Total length (cm) - | Notes |
|---------------|-------|---------------|--------------|--------------|---------------|----------------|----------------|--------------------|---------------------|------------------------------|
| SCH22_VC01 | 12:01 | 51°24.82118'N | 3°14.83268'E | 51.4140785N | 3.2471595E | 51° 24.8195' N | 3° 14.8329'E | 2 | 200 | Core catcher bagged |
| SCH22_VC02 | 12:34 | 51°24.80643'N | 3°14.91888'E | 51.41375782N | 3.24856505E | 51°24.8042' N | 3° 14.8329'E | 3 | 270 | Core catcher bagged |
| SCH22_VC03 | 13:11 | 51°24.80659'N | 3°15.09575'E | 51.41376158N | 3.25151148E | 51°24.8043' N | 3° 15.0971'E | 3 | 240 | Core catcher bagged |
| SCH22_VC04_01 | 13:29 | 51°24.76021'N | 3°15.09118'E | 51.41299880N | 3.25143992E | 51°24.7586' N | 3°15.0921' E | | | FAILED – core catcher broken |
| SCH22_VC04_02 | 14:02 | 51°24.76021'N | 3°15.09118'E | 51.41299677N | 3.25142227E | 51° 24.7587' N | 3° 15.0928' E | 3 | 250 | Core catcher broken |

Wednesday 21/09/2022

| Core name | Time | (i) Lat (N) | (i) Long (E) | (ii) Lat (N) | (ii) Long (E) | (iii) Lat (N) | (iii) Long (E) | Heading | Number of sections | Total length (cm) - | Notes |
|-----------|-------|-------------------|------------------|---------------|---------------|---------------|----------------|---------|--------------------|---------------------|--|
| AX02_01 | 06:03 | 52° 33.42580400'N | 2° 41.75395586'E | 52° 33.4449'N | 2° 41.7531'E | 52°33.4247'N | 2°41.7542'E | 359.8° | | | FAILED - empty |
| AX02_02 | 06:32 | 52° 33.42580400'N | 2° 41.75395586'E | 52° 33.4448'N | 2° 41.7578'E | 52°33.4238'N | 2°41.7542'E | 7.74° | 3 | 265 | 2 core catchers broken |
| AX01_01 | 07:04 | 52° 33.42421285'N | 2° 41.70284452'E | 52° 33.4437'N | 2° 41.7070'E | 52°33.4216'N | 2°41.7033'E | 6.72° | | | FAILED - empty |
| AX01_02 | 07:24 | 52° 33.42421285'N | 2° 41.70284452'E | 52° 33.4438'N | 2° 41.7077'E | 52°33.4217'N | 2°41.7027'E | 7.43° | 2 | 200 | |
| AX03_01 | 07:49 | 52° 33.41581248'N | 2° 41.42270111'E | 52° 33.4351'N | 2° 41.4271'E | 52°33.4135'N | 2°41.4221'E | 7.39° | | | FAILED – empty |
| AX03_02 | 08:05 | 52° 33.41581248'N | 2° 41.42270111'E | 52° 33.4331'N | 2° 41.4265'E | 52°33.4138'N | 2°41.4231'E | 7.56° | | | FAILED – empty |
| AX04 | 09:07 | 52° 36.60564589'N | 2° 42.50277576'E | 52° 36.6246'N | 2° 42.4942'E | 52°36.6036'N | 2°42.5046'E | 345.65° | 3 | 253 | |
| AX05 | 09:35 | 52° 36.59802163'N | 2° 42.21589326'E | 52° 36.6167'N | 2° 42.2070'E | 52°36.5955'N | 2°42.2171'E | 345.65° | 3 | 230 | Bottom cap fell off lower section; roughly 30cm fell out, the lower part has |

| | | | | | | | | | | | |
|---------|-------|-------------------|------------------|---------------|--------------|--------------|-------------|---------|---|-----|---|
| | | | | | | | | | | | been kept in a bag |
| AX06_01 | 09:59 | 52° 36.58924900'N | 2° 41.92909864'E | 52° 36.6075'N | 2° 41.9210'E | 52°36.5868'N | 2°41.9299'E | 345.68° | | | FAILED – catcher broken |
| AX06_02 | 10:38 | 52° 36.58924900'N | 2° 41.92909864'E | 52° 36.6080'N | 2° 41.9207'E | 52°36.5873'N | 2°41.9301'E | 345.44° | | | FAILED – empty core |
| AX06_03 | 10:51 | 52° 36.58924900'N | 2° 41.92909864'E | 52° 36.6068'N | 2° 41.9204'E | 52°36.5864'N | 2°41.9299'E | 345.64° | 2 | 200 | Top part of core in bag |
| AX07_01 | 11:23 | 52° 36.57969973'N | 2° 41.62811905'E | 52° 36.5621'N | 2° 41.6121'E | 52°36.5823'N | 2°41.6288'E | 214.82° | | | FAILED |
| AX07_02 | 11:41 | 52° 36.57969973'N | 2° 41.62811905'E | 52° 36.5638'N | 2° 41.6102'E | 52°36.5821'N | 2°41.6292'E | 214.01° | 1 | 130 | Top 20-30cm in bag |
| AX08 | 12:38 | 52° 39.15857455'N | 2° 40.08009070'E | 52° 39.1399'N | 2° 40.0692'E | 52°39.1601'N | 2°40.0806'E | 199.9° | 3 | 154 | |
| AX09_01 | 12:57 | 52° 39.15818411'N | 2° 39.96416759'E | 52° 39.1405'N | 2° 39.9537'E | 52°39.1604'N | 2°39.9644'E | 199.5° | | | FAILED |
| AX09_02 | 13:31 | 52° 39.15818411'N | 2° 39.96416759'E | 52° 39.1395'N | 2° 39.9530'E | 52°39.1598'N | 2°39.9647'E | 200.1° | 2 | 210 | Core stuck in barrel; was hammered out: sediment likely disturbed |
| AX10_01 | 14:21 | 52° 39.15796416'N | 2° 39.89578677'E | 52° 39.1394'N | 2° 39.8852'E | 52°39.1602'N | 2°39.8966'E | 200.4° | | | FAILED – empty core |
| AX10_02 | 14:31 | 52° 39.15796416'N | 2° 39.89578677'E | 52° 39.1395'N | 2° 39.8852'E | 52°39.1596'N | 2°39.8964'E | 200.3° | | | FAILED – top 10-20cm stored in bag; core barrel bent (banana) |
| AX11 | 15:02 | 52° 39.15991604'N | 2° 39.42411724'E | 52° 39.1578'N | 2° 39.3928'E | 52°39.1606'N | 2°39.4284'E | 264.5° | 3 | 251 | |
| AX12 | 15:34 | 52° 39.15934483'N | 2° 38.23051434'E | 52° 39.1630'N | 2° 38.2822'E | 52°39.1594'N | 2°38.3166'E | 283.1° | 3 | 202 | Top 20-30cm stored in bag |

Thursday 21/09/2022

| Core name | Time | (i) Lat (N) | (i) Long (E) | (ii) Lat (N) | (ii) Long (E) | (iii) Lat (N) | (iii) Long (E) | Heading | Number of sections | Total length (cm) - | Notes |
|-----------|-------|-------------------|------------------|---------------|---------------|---------------|----------------|---------|--------------------|---------------------|----------------------------|
| AX13 | 19:21 | 52° 47.34897314'N | 2° 33.38716528'E | 52° 47.3309'N | 2° 33.3724'E | 52°47.3504'N | 2°33.3876'E | 206.40° | 3 | 247 | Core catcher bagged (clay) |
| AX14_01 | 10:45 | 52° 47.39761394'N | 2° 33.39691153'E | 52° 47.3800'N | 2° 33.3826'E | 52°47.3995'N | 2°33.3982'E | 206.32° | 0 | | FAILED – empty; fell |

| | | | | | | | | | | | |
|---------|-------|-------------------|------------------|---------------|--------------|--------------|-------------|-----------------------------|---|-----|--|
| AX14_02 | 10:59 | 52° 47.39761394'N | 2° 33.39691153'E | 52° 47.3804'N | 2° 33.3829'E | 52°47.3997'N | 2°33.3978'E | 205.9° | 2 | 160 | Sand and clay; core catcher bagged |
| AX15_01 | 11:20 | 52° 47.44484047'N | 2° 33.40637892'E | 52° 47.4268'N | 2° 33.3916'E | 52°47.4468'N | 2°33.4070'E | 206.35° | 0 | | Core was stuck in barrel; core pushed got stuck when trying to hammer it out; in the end we had to flush the core: fine sand |
| AX15_02 | 12:46 | 52° 47.44484047'N | 2° 33.40637892'E | 52° 47.4271'N | 2° 33.3917'E | 52°47.4472'N | 2°33.4064'E | ???? (probably 206-ish°) | 2 | 171 | Some sand flowed out of the bottom |
| AX16 | 08:05 | 52° 47.50074147'N | 2° 33.41759145'E | 52° 47.4830'N | 2° 33.4028'E | 52°47.5024'N | 2°33.4179'E | 206.09° | 2 | 174 | |

Seismic data acquisition

The following lines were acquired on a day-to-day basis. Start and end positions are approximate and may differ from the actual positions as acquired in the header of the seismic and acoustic data.

Friday 16/09/2022 – all times are UTC

| Line Name | Acquisition system | Direction | Start Time | End Time | Start | | End | | Notes |
|-----------|--------------------|-----------|------------|----------|----------------|---------------|----------------|---------------|--|
| | | | | | Lat | Long | Lat | Long | |
| AX22 | TOPAS | S->N | 07:39 | 07:56 | 52° 30.1304' N | 2° 42.6954' E | | | Data acquired @6kn; Line aborted due to poor data quality |
| AX01 | | W->E | 08:24 | 09:14 | 52° 31.3635' N | 2° 38.777' E | 52° 43.3770' N | 2° 46.258' E | |
| AX02 | | E->W | 09:27 | 10:16 | 52° 32.1039' N | 2° 45.9075' E | 52° 31.8390' N | 2° 38.5318' E | |
| AX03 | | W->E | 10:26 | 11:21 | 52° 32.0093' N | 2° 38.3597' E | 52° 32.6634' N | 2° 45.9856' E | |
| AX04 | | E->W | 11:31 | 12:31 | 52° 33.0440' N | 2° 45.3166' E | 52° 32.7569' N | 2° 38.3295' E | Data becoming increasingly worse |
| Transit | | SW | 12:32 | | 52° 32.7569' N | 2° 38.3295' E | | | |

Monday 19/09/2022 – all times are UTC

| Line Name | Acquisition system | Direction | Start Time | End Time | Start | | End | | Notes |
|-----------|--------------------|-----------|------------|----------|----------------|---------------|---------------|---------------|--------------------------------------|
| | | | | | Lat | Long | Lat | Long | |
| AX07 | TOPAS | W->E | 09:42 | 10:29 | 52° 34.5399' N | 2° 38.2132' E | 52° 34.922' N | 2° 46.047' E | Data acquired @6kn; |
| AX09 | | E->W | 10:45 | 11:35 | 52° 36.117' N | 2° 45.94' E | 52° 35.731' N | 2° 37.5720' E | |
| AX12 | | W->E | 12:00 | 12:53 | 52° 37.2073' N | 2° 37.2073' E | 52° 37.820' N | 2° 45.9790' E | Data becoming worse towards the East |
| AX14 | | E->W | 13:09 | 14:11 | 52° 38.7193' N | 2° 46.086' E | 52° 38.418' N | 2° 36.1313' E | |
| AX16 | | W->E | 15:03 | 16:47 | 52° 40.066' N | 2° 29.331' E | 52° 40.258' N | 2° 46.338' E | |
| AX18 | | E->W | 17:08 | 18:49 | 52° 42.304' N | 2° 46.496' E | 52° 42.276' N | 2° 30.381' E | |
| AX19 | | W->E | 19:22 | 21:18 | 52° 44.329' N | 2° 26.822' E | 52° 43.754' N | 2° 45.945' E | |
| AX21 | | E->W | 21:42 | 23:38 | 52° 45.304' N | 2° 45.635' E | 52° 46.973' N | 2° 26.426' E | |

Tuesday 20/09/2022 – all times are UTC

| Line Name | Acquisition system | Direction | Start Time | End Time | Start | | End | | Notes |
|-----------|--------------------|-----------|------------|-----------|----------------|---------------|----------------|---------------|-------------------------------|
| | | | | | Lat | Long | Lat | Long | |
| W01 | TOPAS | W->E | 23:47 (-1) | 01:57 | 52° 47.6602' N | 2° 26.8288' E | 52° 49.5468' N | 2° 46.0985' E | Data acquired @6kn; |
| W02 | | E->W | 01:58 | 04:22 | 52° 49.5468' N | 2° 46.0985' E | 52° 54.2372' N | 2° 24.2010' E | |
| W03 | | W->E | 04:27 | 06:48 | 52° 54.4920' N | 2° 24.5356' E | 52° 56.5427' N | 2° 47.1234' E | |
| W04 | | E->W | 06:50 | 09:12 | 52° 56.6163' N | 2° 47.2224' E | 53° 02.9128' N | 2° 25.3553' E | |
| W05 | | W->E | 09:13 | 11:29 | 53° 02.9624' N | 2° 25.4369' E | 53° 05.076' N | 2° 48.076' E | |
| W06 | | E->W | 11:32 | 13:18 | 53° 05.362' N | 2° 47.824' E | 53° 10.205' N | 2° 30.823' E | |
| W07 | | W->E | 13:39 | 15:54 | 53° 12.161' N | 2° 31.519' E | 53° 15.890' N | 2° 51.469' E | |
| W08 | | E->W | 15:59 | 17:24 | 53° 16.127' N | 2° 52.918' E | 53° 18.696' N | 2° 37.980' E | |
| W09 | | W->E | 17:48 | 18:45 | 53° 20.962' N | 2° 38.733' E | 53° 20.043' N | 2° 48.002' E | Stop halfway to start transit |
| W17 | | N->S | 18:46 | 00:25(+1) | 53° 20.010' N | 2° 47.973' E | 52° 47.3865' N | 2° 33.5126' E | |

Wednesday 21/09/2022 – all times are UTC

| Line Name | Acquisition system | Direction | Start Time | End Time | Start | | End | | Notes |
|---------------------|---|-----------|------------|----------|-----------------|-----------------|----------------|----------------|------------------------|
| | | | | | Lat | Long | Lat | Long | |
| AX22 | TOPAS | N->S | 00:25 | 03:26 | 52° 47.3865' N | 2° 33.5126' E | 52° 30.0068' N | 2° 43.0014' E | |
| Transit_coresites_1 | | S->N | 00:29 | 05:34 | 52° 30.06791' N | 2° 43.07694' E | 52° 33.423' N | 2° 41.7500' E | Reduced speed to 1-2kn |
| Transit_coresites_2 | | S->N | 08:35 | 08:57 | 52° 34.8010' N | 2° 41.9630' E | 52° 36.5871' N | 2° 42.47310' E | @6kn |
| Transit_coresites_3 | | S->N | 11:45 | 12:22 | 52° 36.5877' N | 2° 41.5843' E | 52° 39.1750' N | 2° 40.0661' E | |
| AX15 | TOPAS, Sparker (MBES at 19:06) | W->E | 17:50 | 19:52 | 52° 39'02.70' N | 2° 35'36.50'' N | 52° 39.3631' N | 2° 46.0341' E | |
| AX17t | | S->N | 19:53 | 20:30 | 52° 39.3079' N | 2° 46.2000' E | 52° 41.3000' N | 2° 46.0131' E | |
| AX17 | | E->W | 20:30 | 23:31 | 52° 41.2998' N | 2° 46.0131' E | 52° 41.1626' N | 2° 29.5852' E | |

| | | | | | | | | | |
|--------|--|------|-------|-------|----------------|---------------|----------------|---------------|--|
| AX18Bt | | S->N | 23:31 | 23:59 | 52° 41.1626' N | 2° 29.5852' E | 52° 42.5200' N | 2° 30.0957' E | |
|--------|--|------|-------|-------|----------------|---------------|----------------|---------------|--|

Thursday 22/09/2022 – all times are UTC

| Line Name | Acquisition system | Direction | Start Time | End Time | Start | | End | | Notes |
|----------------------|----------------------|-----------|------------|----------|----------------|---------------|----------------|---------------|--|
| | | | | | Lat | Long | Lat | Long | |
| AX18B | TOPAS, Sparker, MBES | W->E | 00:00 | 02:46 | 52° 42.5201' N | 2° 30.0957' E | 52° 42.4412' N | 2° 46.6786' E | |
| AX20t | | S->N | 02:47 | 03:30 | 52° 42.4473' N | 2° 46.7550' E | 52° 44.4892' N | 2° 46.6748' E | |
| AX20 | | E->W | 03:30 | 07:25 | 52° 44.4892' N | 2° 46.6748' E | 52° 45.6007' N | 2° 26.8254' E | |
| AX20_Transit to VC | | SW->NE | 07:25 | 09:33 | 52° 45.6007' N | 2° 26.8254' E | 52° 47.8731' N | 2° 34.8276' E | 07:42 - Sparker stopped working 07:45 – Sparker restarted |
| Transit to core AX13 | TOPAS | E->W | 09:51 | 10:05 | 52° 47.4012' N | 2° 43.931' E | 52° 47.3771' N | 2° 33.406' E | |
| Transit to line AX02 | TOPAS | N->S | 13:00 | 15:04 | 52° 47.4238' N | 2° 33.3749' E | 52° 38.5987' N | 2° 31.8431' E | |
| AX02 | TOPAS, Sparker, MBES | W->E | 15:20 | 17:01 | 52° 31.7845' N | 2° 38.0377' E | 52° 32.1514' N | 2° 45.8797' E | 16:40 TOPAS started logging for a few minutes |
| AX02t | | S->N | 17:01 | 17:24 | 52° 32.1514' N | 2° 45.8792' E | 52° 33.0962' N | 2° 45.9629' E | |
| AX04 | | E->W | 17:24 | 18:58 | 52° 33.0962' N | 2° 45.9620' E | 52° 32.7838' N | 2° 37.8097' E | |
| AX05t | | S->N | 18:58 | 19:12 | 52° 32.7838' N | 2° 37.8097' E | 52° 33.2914' N | 2° 37.7974' E | |
| AX05 | | W->E | 19:12 | 20:43 | 52° 32.9514' N | 2° 37.9323' E | 52° 33.6384' N | 2° 46.3210' E | |
| AX06t | | S->N | 20:43 | 21:05 | 52° 33.6384' N | 2° 46.3210' E | 52° 34.2675' N | 2° 46.2528' E | |
| AX06 | | E->W | 21:05 | 22:36 | 52° 34.2675' N | 2° 46.2528' E | 52° 33.8836' N | 2° 37.7064' E | |
| AX08t | | S->N | 22:37 | 23:02 | 52° 33.8836' N | 2° 37.7064' E | 52° 35.0621' N | 2° 37.8048' E | |
| AX08 | | W->E | 23:03 | 00:28 | 52° 35.0621' N | 2° 37.8048' E | 52° 35.5665' N | 2° 45.8099' E | |

Friday 23/09/2022 – all times are UTC

| Line Name | Acquisition system | Direction | Start Time | End Time | Start | | End | | Notes |
|-----------|----------------------|-----------|------------|-----------|----------------|----------------|----------------|---------------|---|
| | | | | | Lat | Long | Lat | Long | |
| AX10t | TOPAS, Sparker, MBES | S->N | 00:28 | 00:55 | 52° 35.5665' N | 2° 45.8099' E | 52° 36.7201' N | 2° 45.6249' E | Sparker and streamer were crossing (are close together) in the turn; reported to bridge |
| AX10 | | E->W | 00:55 | 02:26 | 52° 36.7455' N | 2° 45.50753' E | 52° 36.3611' N | 2° 36.9989' E | |
| AX11t | | S->N | 02:26 | 02:45 | 52° 36.3611' N | 2° 36.9989' E | 52° 36.9161' N | 2° 36.8719' E | 2:36 Sparker turned off (too close to sparker) 2:44 Sparker turned back on |
| AX11 | | W->E | 02:45 | 04:24 | 52° 36.9161' N | 2° 36.8719' E | 52° 37.2700' N | 2° 46.1328' E | |
| AX13t | | S->N | 04:24 | 04:46 | 52° 37.2700' N | 2° 46.1328' E | 52° 38.1926' N | 2° 46.0147' E | |
| AX13 | | E->W | 04:46 | 06:25 | 52° 38.1926' N | 2° 46.0147' E | 52° 37.9369' N | 2° 36.9228' E | |
| W09t | TOPAS @10kn | S->N | 06:41 | 10:15 | 52° 37.9750' N | 2° 35.8715' E | 53° 20.8553' N | 2° 42.5780' E | |
| W09_2 | TOPAS @6kn | W->E | 10:50 | 13:09 | 53° 20.8553' N | 2° 42.5180' E | 53° 21.4973' N | 3° 06.1987' E | Some artefacts at end of line |
| W10 | | E->W | 13:13 | 15:59 | 53° 21.7593' N | 3° 06.1646' E | 53° 27.8215' N | 2° 45.2278' E | |
| W11_SN | | S->N | 15:59 | 16:37 | 53° 27.8215' N | 2° 45.2278' E | 53° 31.1843' N | 2° 48.2054' E | |
| W11_WE | | W->E | 16:38 | 19:04 | 53° 31.2051' N | 2° 48.2808' E | 53° 26.6695' N | 3° 10.9739' E | |
| W12_SN | | S->N | 19:04 | 22:05 | 53° 26.6695' N | 3° 10.9739' E | 53° 43.5827' N | 3° 18.9413' E | |
| W13_EW | | E->W | 22:05 | 02:31(+1) | 53° 43.5827' N | 3° 18.9413' E | 53° 39.6260' N | 2° 32.9790' E | |

Saturday 24/09/2022 – all times are UTC

| Line Name | Acquisition system | Direction | Start Time | End Time | Start | | End | | Notes |
|-----------|--------------------|-----------|------------|----------|----------------|---------------|----------------|---------------|-------|
| | | | | | Lat | Long | Lat | Long | |
| W14 | TOPAS @6kn | S->N | 02:31 | 05:51 | 53° 39.6260' N | 2° 32.9790' E | 53° 56.7219' N | 2° 50.4565' E | |
| W15 | | W->E | 05:51 | 09:03 | 53° 56.7219' N | 2° 50.4565' E | 53° 59.950' N | 3° 21.295' E | |

| | | | | | | | | | |
|-------|--|--------|-------|-----------|----------------|---------------|----------------|---------------|---|
| W16 | | NE->SW | 09:03 | 11:31 | 53° 59.950' N | 3° 21.295' E | 53° 47.881' N | 3° 04.058' E | |
| W17 | | N->S | 11:31 | 16:29 | 53° 47.881' N | 3° 04.058' E | 53° 19.6402' N | 2° 47.8203' E | |
| W17_2 | | N->S | 16:29 | 21:48 | 53° 19.6402' N | 2° 47.8203' E | 53° 47.5995' N | 2° 38.0430' E | |
| W18 | | N->S | 21:48 | 00:41(+1) | 53° 47.5995' N | 2° 38.0430' E | 52° 30.2263' N | 2° 42.7507' E | TOPAS stopped logging at 23:34; restarted |

7. REMARKS

During the first 4 days of the survey (15-18/9), the weather was very stormy (between 5 and 8 Bft). It was decided to leave port anyway and test the TOPAS in heavy seas. Acceptable data were obtained with TOPAS with waves up to 2m (waves higher than 2.5m resulted in gaps in the data). At the point when data acquisition became compromised, it was decided to seek shelter off the UK coast for a period of 2 days (17&18/9). As weather gradually improved on 19/9, the TOPAS work could be continued, notwithstanding wave heights of >1.5 m at the onset. Sparker requires much calmer seas and was only started on 21/9. Two days of coring were done during good weather and calm seas (on 21 & 22/9), resulting in 14 cores ranging in length between 1m and 2.8m. MBES performed well throughout the entire campaign.

Due to the storm period only 75% of the planned work could be performed. Out of the 16 vibrocores planned in the study area, a total of 14 were obtained (2 failed cores). The latter was due to problems with the liners and core barrel, most likely a result of locally hard sandy substrate. The vibrocore unit itself functioned very well and deployment was smooth. The cores were opened and described on board in the ship's lab, which helped to save a lot of valuable time.

Some of the seismic line positions were slightly altered during the survey in order to keep well clear of oil and gas installations.

We would like to thank the RV *Belgica* captain and crew for their efforts and cooperation. Their skilfulness on-board contributed greatly to the success of this survey.

8. DATA STORAGE

Seismic subbottom data were saved in TOPAS format and were converted to SEGY (raw and processed); Sparker data were recorded in SEGY; the MBES data were acquired in .all. During the survey, a back-up of all data was saved on an external hard drive. These data will be copied onto the VLIZ seismic archive server. Data can be shared on request.

In accordance with the UK diplomatic clearance agreement, a copy of this report together with a shapefile of the ship's track will be sent to BODC (enquiries@bodc.ac.uk) and the Foreign, Commonwealth & Development Office, Ocean Policy Unit (msrapplications@fcdo.gov.uk). The UKHO have been contacted to discuss the data transfer of bathymetric data (David.Parker@UKHO.gov.uk), but we are currently (28/09/2022) awaiting their response.

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