IWT SBO PROJECT 120003 "SEARCH"

Archaeological heritage in the North Sea

Development of an efficient assessment methodology and approach towards a sustainable management policy and legal framework in Belgium.

Archeologisch erfgoed in de Noordzee

Ontwikkeling van een efficiënte evaluatiemethodologie en voorstellen tot een duurzaam beheer in België.

SEISMIC CAMPAIGN SIMON STEVIN (Cruise No. 18-800) 10-4 OCTOBER 2016

Responsible partners: UG-RCMG, VLIZ
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1. Framework and objectives

1.1. Framework

In October 2016, 270 kilometres of 2D high resolution seismic reflection data were acquired in the northwestern part of the Belgian Continental Shelf (figure 1) in the framework of the IWT-SBO project SeArch ("Archaeological heritage in the North Sea: development of an efficient methodology and approach towards a sustainable management policy and legal framework in Belgium"). The purpose of this project is to assess the archaeological potential of the Quaternary deposits in the Belgian part of the North Sea. To this date no efficient survey methodology exists that is particularly aimed at archaeological assessment studies. Standard geophysical and remote sensing techniques are mainly used on an *ad hoc* basis (if at all) and these techniques are often not well adapted for archaeological investigations. Moreover they are ineffective in large parts of the nearshore zone due to the presence of biogenic gas in the sediments, and generally cannot be applied appropriately in intertidal areas.

One of the main goals of the SeArch project is to supply a flexible, generic survey methodology through the development and improvement of marine geophysical and remote sensing techniques for seafloor and sub-seafloor imaging, with major focus on acquisition (sources/receivers), data processing and interpretation of high-quality data. This should allow a cost-efficient and accurate assessment of the archaeological potential of the seafloor and sub-seafloor environment.

The acquired data will also be applied in a post-track doctoral research of the SeArch project (IWT PhD grant M. De Clercq). This PhD research aims at developing an 'archaeological potential map' of the Belgian part of the North Sea (BCS) indicating the sensitivity of marine areas to human settlements and their remnants. Such a map will contribute to an increase in cost-efficiency and accurate assessment of marine works at sea regarding the archaeological potential of that working area.

1.2. Survey Objectives

The seismic campaign, carried out on board of the RV Simon Stevin, had multiple objectives:

- Survey areas with scarce seismic coverage in north-western part of the Belgian Continental Shelf and follow the continuity of the geological features further north into British waters.

- Identify archaeological potential of geological layers and seafloor.

2. Study area

The study area comprises the north-western part of the Belgian Continental Shelf (BCS) extending into British waters. This area is believed to be strongly influenced by fluvial processes by the Rhine and the Meuse during periods of lower sea-level. It is these depositional environments of specifically the last ice age that have been preserved.

Due to deterioration of the weather a number of seismic lines were recorded in more sheltered waters closer to the shore, in the vicinity of Zeebrugge harbour.

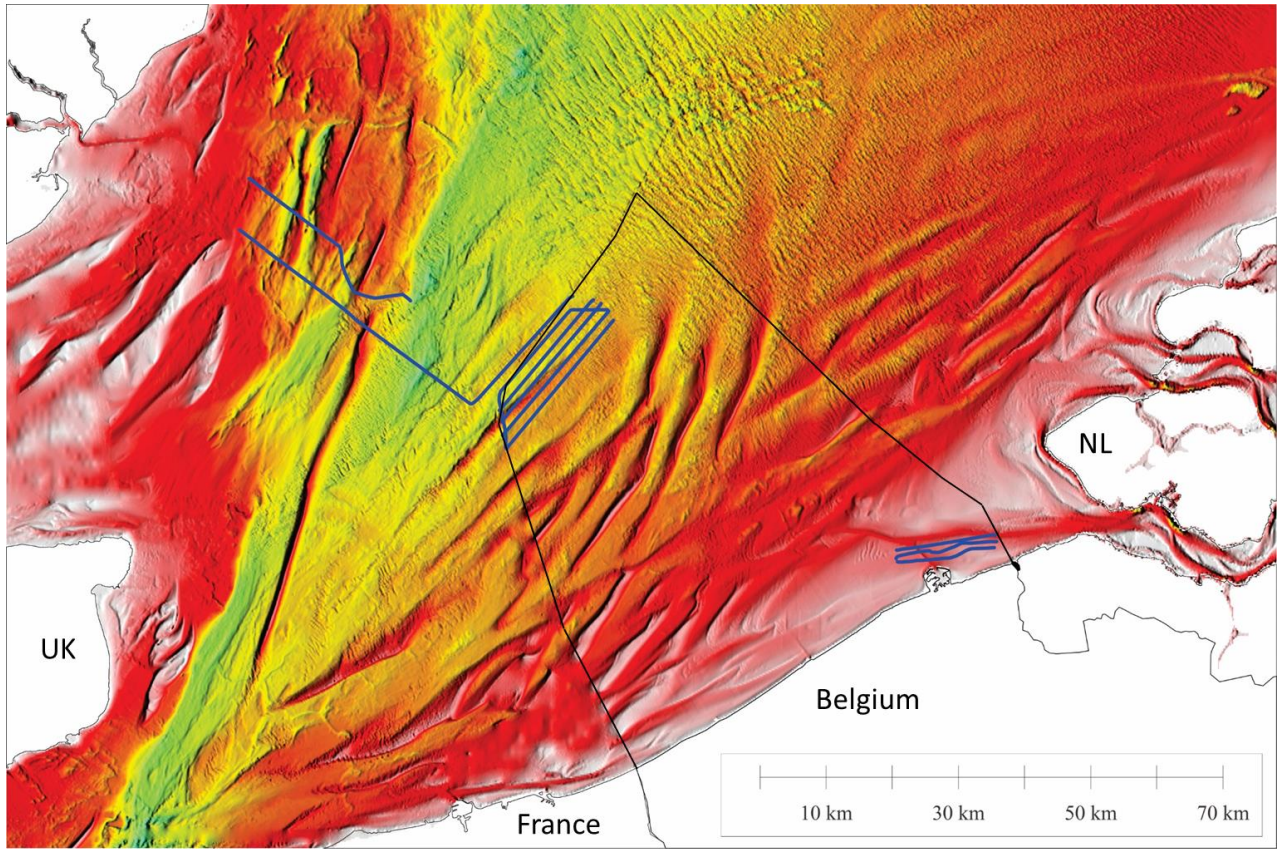

Figure 1 – Study area and performed seismic lines depicted on top of the seafloor bathymetry.

3. List of participants

Name	Organisation	Function	10/10	11/10	12/10	13/10	14/10
Oscar Zurita Hurtado	RCMG	Geophysicist	x	x	x		x
Koen De Rycker	RCMG	Engineer	x	x	x		x
Maikel De Clercq	RCMG	Geologist	x	x	x		x

Vasileios Chademenos	RCMG	Geologist	x	x	x
David Garcia Moreno	RCMG	Geologist	x	x	x
Maikel De Clercq	UGent	Student	x	x	x

Table 1 – List of participants

4. Operations and data acquisition

4.1. Equipment and specifications

The folowing seismic source was used throughout the survey:

Table 1 - Characteristics of the equipment used during the survey.

Equipment	Frequency range	Vertical Resolution	Penetration
GSO 360 tips Sparker	500-2000 Hz	50 cm	Up to 250m

A single channel (SC) streamer was used to register the data.

The seismic source was towed at starboard of the ship and the SC streamer was towed at port side. The longitudinal offset was held at a constant distance of roughly 30m. The nominal lateral distance between the source and the streamer was six metres (see figure 2).

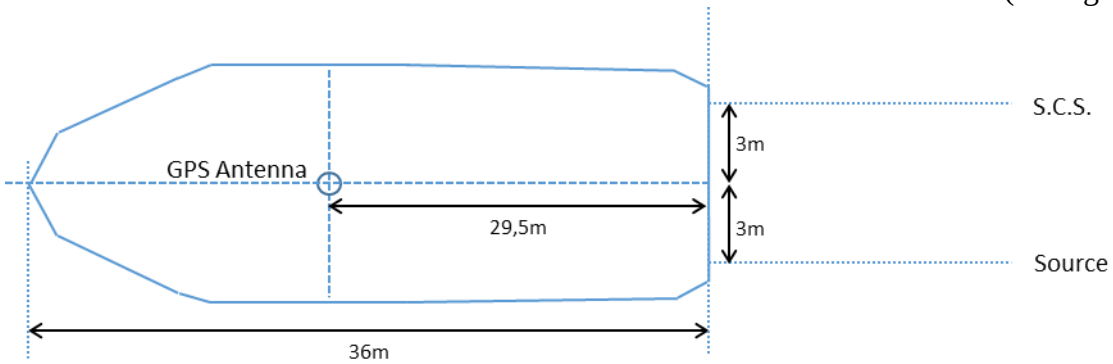

Figure 2 - Sketch of the vessel illustrating the equipment configuration.
SCS = Single Channel streamer. Sketch is not to scale.

4.2. Survey log (in local time, GMT + 2)

Monday 10th October
09:00 Embarking and installation of equipment on board of RV Simon Stevin
12:00 Installation completed and sparker tested in the water
12:15 Departure from harbour of Ostend and transit to survey area
15:15 Arrival at survey area and deployment of seismic instruments in the water
15:30 Preliminary tests performed
16:00 Start seismic measurements on line BB16_17

Tuesday 10th October
00:00 – 24:00 Continuation of seismic acquisition
20:00 Weather conditions started to deteriorate

Wednesday 11th October
01:00 Seismic acquisition stopped due to bad weather conditions
01:15 Sparker and streamer hauled in; transit to Zeebrugge
05:00 Arrival at new survey area
05:10 Deployment of seismic instruments in the water
05:25 Start seismic measurements on line VB16_01
10:00 Weather conditions deteriorated very fast
12:00 End of seismic measurements; sparker and streamer hauled in; transit to Ostend.
14:00 Arrival at the quay in Ostend. Scientific personnel abandoned the survey but left equipment on site on board of the vessel.
14:00 – 24:00 Personnel and equipment on stand-by waiting for improvement of weather conditions

Thursday 12th October
00:00 – 11:00 Personnel and equipment on stand-by waiting for improvement of weather conditions
11:00 Survey cancelled due to bad weather conditions

Friday 13th October
08:00 – 15:00 Demobilization of equipment from RV Simon Stevin.

4.3. Wave height average

Figure 3 - wave height measurement obtained from pile Westhinder. Source: meetnetvlaamsebanken.be/. The survey period is marked by the red striped lines. Wave heights between 1 and 2 m during the second part of the week caused the survey to be cancelled.

5. Line Summary

Date	Line No	SOL	EOL	Source	Receiver	Shot Interval (sec)	Sample Rate (ms)	Wind BFT	Speed KN	Direction
10/10/2016	BB16_17	14:05	17:15	Sparker 360	SCS	1	0,125	3	4-5	SW-NE
10/10/2016	BB16_16	17:28	20:35	Sparker 360	SCS	1	0,125	3	4-5	NE-SW
10/10/2016	BB16_19	21:13	00:37	Sparker 360	SCS	1	0,125	4	4-5	SW-NE
11/10/2016	BB16_19_to_15	00:39	01:25	Sparker 360	SCS	1	0,125	4	4-5	E-W
11/10/2016	BB16_15	01:27	03:35	Sparker 360	SCS	1	0,125	3	4-5	NE-SW
11/10/2016	BB16_15_to_18	03:36	04:30	Sparker 360	SCS	1	0,125	3	4-5	N-S
11/10/2016	BB16_18	04:33	07:52	Sparker 360	SCS	1	0,125	3	4-5	SW-NE
11/10/2016	BB16_14	08:31	11:36	Sparker 360	SCS	1	0,125	3	4-5	NE-SW
11/10/2016	BB16_01	11:36	14:11	Sparker 360	SCS	1	0,125	3	4-5	SE-NW
11/10/2016	BB16_01_01	14:11	16:34	Sparker 360	SCS	1	0,125	3	4-5	SE-NW
11/10/2016	BB16_01_02	16:38	16:40	Sparker 360	SCS	1	0,125	4	4-5	SE-NW
11/10/2016	BB16_01_03	16:41	17:15	Sparker 360	SCS	1	0,125	4	4-5	SE-NW
11/10/2016	BB16_04	17:58	20:48	Sparker 360	SCS	1	0,125	4	4-5	NW-SE
11/10/2016	BB16_04_1	20:48	22:32	Sparker 360	SCS	1	0,125	5	4-5	NW-SE
12/10/2016	VB16_01	03:23	05:21	Sparker 360	SCS	1	0,125	5	4-5	W-E
12/10/2016	VB16_02	05:28	07:32	Sparker 360	SCS	1	0,125	5	4-5	E-W
12/10/2016	VB16_03	07:36	09:46	Sparker 360	SCS	1	0,125	5	4-5	W-E

Table 8 - Representation of the characteristics of the recorded seismic lines during the March 2016 survey. Time in GMT

Appendix A

Survey photos

Figure 4 – GSO sparker and High Voltage Power Supply Units

Figure 5 – GSO sparker and SC streamer towed behind the RV Simon Stevin

Figure 6 – Recording laboratory

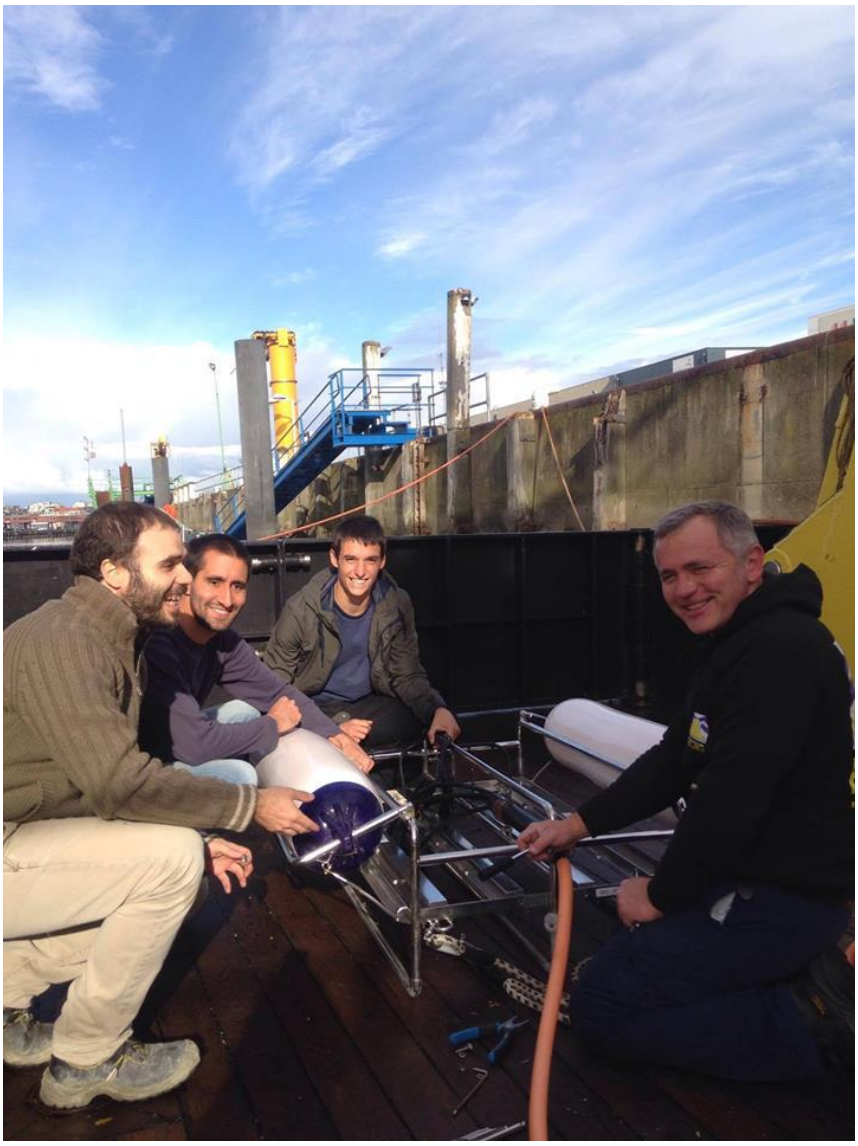

Figure 7– Installation of the sparker source