Comparative Seismic Source Study for Buried Palaeolandscape Investigations in the Southern North Sea

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1.Introduction

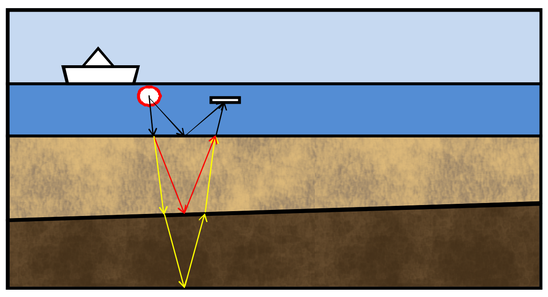
The main objective of this study is to develop an efficient survey methodology capable of i**maging buried palaeolandscapes** in the Belgian Continental Shelf (BCS) through the comparison of different high-resolution seismic source/receiver configurations.

It is not our intention to come up with a list of 'good' or 'bad' techniques since the potential of each method does not only depend on the environmental setting but also on the type of geo-archaeological indicator (e.g. wood/stone structures, organic deposits, river valleys, ...).

The resulting methodology is intended to be a **guide** for all those involved in commercial activities at sea (aggregate industry, wind farm developers, ...) as well as the scientific community.

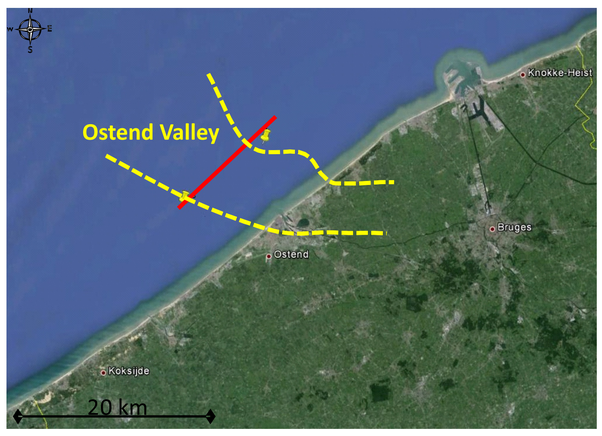
2.Methodology

Marine seismic techniques are based on artificially sending acoustic waves into the Earth. Some of the acoustic signal is reflected from the seafloor, whereas the remainder penetrates the seafloor and is reflected when it encounters boundaries between layers that have different acoustic impedance. Measuring the time required for the waves to travel back to an acoustic receiver allow us to deduce information of the structure of the propagating media.



3.Data Acquisition

In 2013 and 2014 about 1000 line km of 2D HR seismic reflection data were acquired at the on the Belgian Continental Shelf. Our test line crosses the **Ostend Valley** perpendicularly at its deepest location where it is covered by a large sandbank. This setting represents a big **challenge** as the short wavelength sound waves are quickly absorbed in the heterogeneous coarse sandy sediments, producing a decrease in penetration depth.

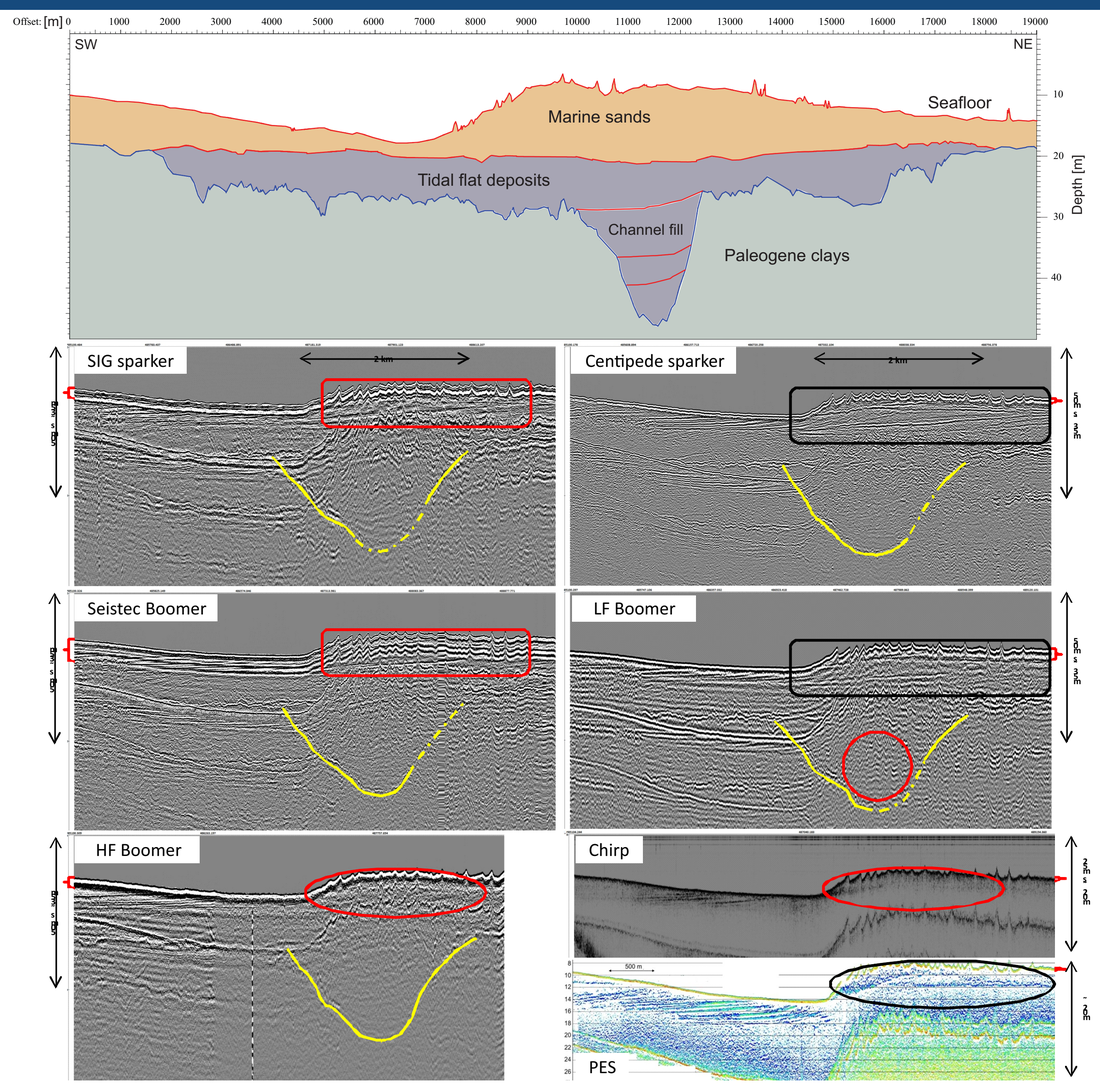


The test line was covered using **seven different seismic sources** and data recorded with **two different streamers** simultaneously.

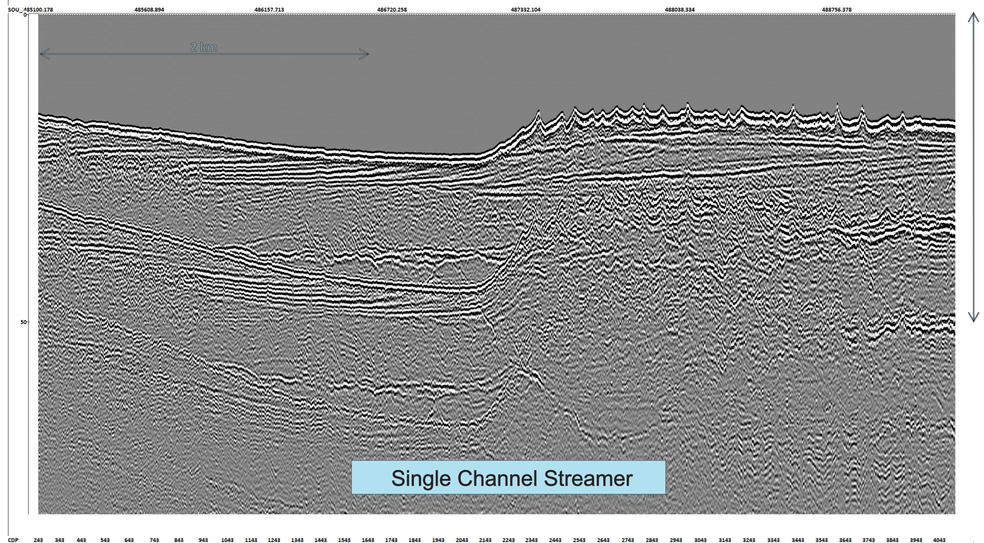
	Seismic Source	Frequency Range (Hz)	Vertical resolution (m)	Penetration (m)
1	SIG sparker	300 – 1800	> 0.50	< 100
2	RCMG Centipede sparker	800 – 2000	> 0.35	< 50
3	Seistec boomer	1000 – 5000	> 0.25	< 20
4	LF-500J boomer	1000 – 4000	> 0.35	< 50
5	HF-300J boomer	3500 – 7000	> 0.25	< 30
6	Edgetech X-Star chirp	500 – 12000	> 0.20	< 15
7	Parametric EchoSounder	6000 – 12000	> 0.15	< 15

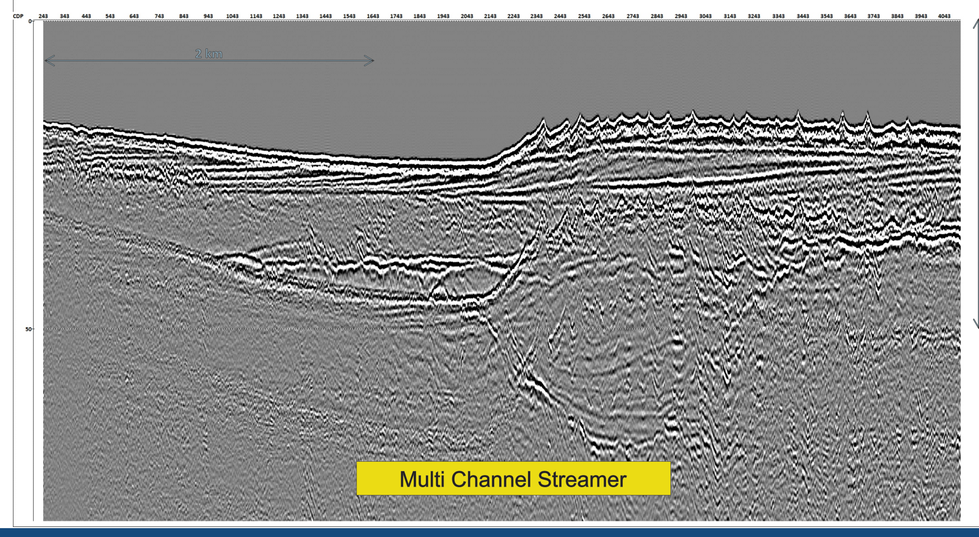
	No of channels	Hydrophones per group	Distance between hydrophones	Distance between channels
Single Channel	1	10	30 cm	N.A.
Multi Channel	24	4	40 cm	3.125 m

4.Results



The **Centipede Sparker** shows the best resolution and penetration depth of all tested sources throughout the section. Comparing single channel results for the centipede with those obtained using the multi channel streamer show a distinct improvement.





5.Conclusions and Recommendarions

The acquisition configuration must be **adapted to survey objectives** and to geological setting, weather conditions and sea-state. For the Ostend Valley we recommend the Centipede sparker in combination with the Parametric Echosounder to get the highest resolution information of both shallow and deep events. For targets deeper than a few tens of metres, and in combination with a shallow water column, we recommend **multichannel acquisition** over single channel sub-bottom profiling.

Het hier voorgestelde onderzoek kadert in het SeArch project "*Archeologisch erfgoed in de Noordzee. Ontwikkeling van een efficiënte evaluatiemethodologie en voorstellen tot een duurzaam beheer in België.*" Dit 4-jarig project (2013-2016) wordt gefinancierd door het Agentschap voor Innovatie door Wetenschap en Technologie (IWT). Het multidisciplinair consortium omvat de volgende partners: Universiteit Gent (coördinator), Agentschap Onroerend Erfgoed, Vlaams Instituut voor de Zee (VLIZ), en Deltares (Nederland).