

Seismic investigation and vibrocore study in Exploration zone 4 on the Belgian Continental Shelf

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Introduction: Large projects are under study in Belgium - Region of Flanders, in order to improve the protection against flooding by the sea. These projects require huge amounts of sand for beach nourishments, so the need of a new exploitation zone of sand arose. In order to obtain a new concession within exploration zone 4 on the Belgian Continental Shelf, a preliminary investigation was conducted to find the sediments with the best characteristics. Exploration zone 4 concerns the area of the Hinder Banks, i.e. a zone with massive tidal sandbanks known for their coarse grained surface sediments, 35 km off the coast of Oostende.

Methodology: An area of 312 km² was covered with a dense network of high-resolution seismic profiles, with a spacing of 500 m. In total, 700 km of Applied Acoustics boomer data revealed the internal structure of the sandbanks. In order to ground-truth the seismic structures, 120 vibrocore locations were chosen based on the seismic data. The vibrocores have an average length of 3.7 m, with a maximum of 5 m. Samples are taken from every lithological entity with uniform characteristics, leading to an average of 4.6 samples per core. For each sample, the grain-size distribution and calcium content were determined, as these parameters determine the quality of the sediment.

Results: The Hinder Banks consist of a Holocene tidal sandbank at the top, and a layer of Eemian estuarine deposits at the base which outcrops at the flanks of the banks, and in the swales in between the banks [1]. This sequence is positioned on top of the Tertiary erosional surface. On top of the Tertiary and Eemian surfaces always a gravel lag of 10-50 cm is present, consisting of coarse to very coarse sand (300-2000 µm), with many shells and gravel. The Eemian deposits are very heterogeneous.

They consist of very fine, medium fine, medium coarse, to coarse and very coarse sands with mostly low calcium content (0-10%). Where the Eemian is exposed at the seafloor, it can be exploited, so the different lithologies are mapped, to distinguish the areas of interest for extraction. Concerning the tidal sandbanks: lithological changes (grain-size and calcium content representative for shell content) do not always show on the seismic data, and conversely, certain seismic reflectors show no differences in the lithology. Still, some general conclusion could be drawn. The main body of the tidal sandbanks consists of medium coarse sand (210-300 µm) with a low calcium content, but often the top of the banks consists of a very coarse sand layer (300-420 µm). Also where active sand dunes are present, recognizable on seismic data as dunes with strong prograding reflectors and sharp crests, the lithology is usually characterised by very coarse sand, but with an increased shell content.

Conclusion: Based on the integration of the seismic and core data, several classes with a specific grain size and calcium content could be mapped (depth and thickness). From these maps, an area of 46 km² will be selected for the dredging of the required sediments. Their will be strived for a sustainable management of the exploitation zone. Thus, a spreading is suggested, i.e. exploration both on the banks and in the swales, in order to reduce its impact, and to minimize possible changes in the current patterns.

References:

[1] Mathys, M. 2009. The Quaternary geology of the Belgian Continental Shelf (southern North Sea). PhD thesis, Ghent University.