**Parametric subbottom-profilers**

**Principle**: The parametric echosounder is a dual frequency subbottom-profiler. The non-linear parametric echosounder simultaneously transmits two signals of slightly different high frequencies (e.g. 100 and 110 kHz). Their interaction generates by interference a new low-frequency signal (with the difference frequency, in this case 10 kHz).

**Basic features**: The generated signal is signified by a large band width, a short signal length (0.07 ms) and a very restricted beam width (±1.8° at 4-15 kHz). The extremely narrow beam makes searching for some types of objects rather time-consuming. Penetration depth will highly depend on the bottom sediments, for soft muddy sediments penetration can be up to 50m.

**Resolution and horizontal precision**: The system has a high vertical resolution (around 15 cm) and good use in very shallow water environments (thanks to the short signal length). The fact that transducer and receiver are in the same position allows for a higher precision in the horizontal positioning of features observed than if the reflected signal was picked up by a hydrophone array located some distance away from the source.

**Platforms**: The parametric echosounder can be operated from small vessels. The transducer is normally attached to the side of the ship, and only a signal processing and recording unit is needed on board.

**Advantages**:
- Very high resolution
- Simple to use
- Operated from very small vessels
- High potential for landscape reconstruction
- Also for very shallow water
- Small objects (dm range) can be detected

**Disadvantages**:
- Difficult penetration in hard sandy layers
- 2D image of the subbottom, no 3D
- Small beam width makes searching for objects rather time-consuming
- Image distorted by gas in sediments

**Literature**:
Wunderlich, J., Wendt, G. and Müller, S. 2005: High-Resolution Echo-Sounding and Detection of Embedded Archaeological Objects with Nonlinear Sub-Bottom Profilers. Marine Geophysical Researches 2-4 (2005), 123-133.

Missiaen, T. 2010: The potential of seismic imaging in marine archaeological site investigations. ***Relicta*** 6 (2010), 219-236.

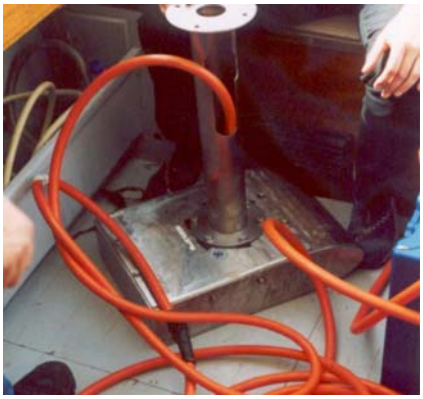

*Fig. 1 Parametric echosounder transducer and power cable. (© Innomar)*

*Fig. 2 Parametric echosounder transducer mounted onto a pole attached to the front of a small vessel. A GPS antenna is attached to top of the pole. Next to the pole a motion sensor is mounted on the deck. (© RCMG Universiteit Gent).*

*Fig. 3 Parametric echosounder acquisition unit (below) and navigation laptop (top) on board a small survey vessel. (© RCMG Universiteit Gent).*

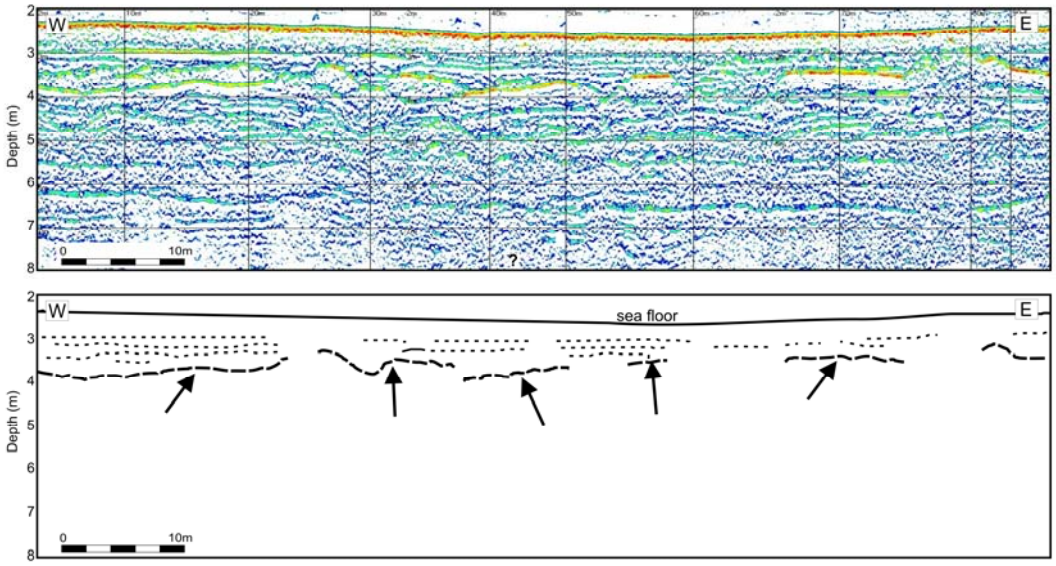


*Fig. 4 Parametric echosounder profile and interpreted line-drawing off the Belgian coast in very shallow water (2 m). The shallow features marked by arrows are probably linked to peat excavation. (© RCMG Universiteit Gent).*

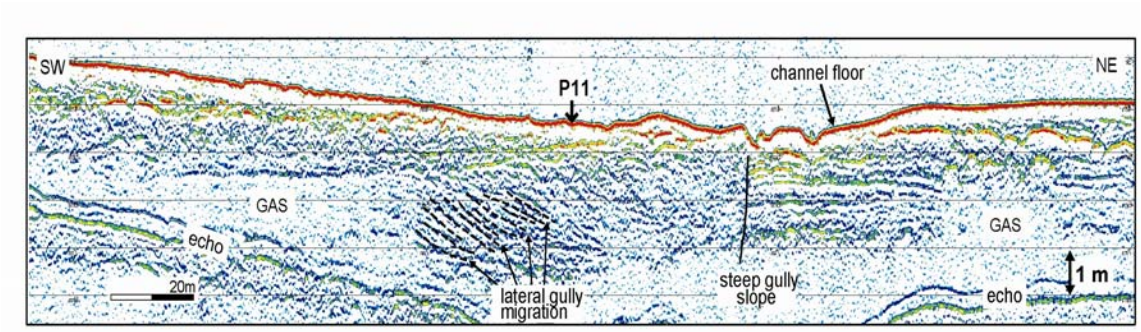


*Fig. 5 Parametric echosounder profile from a tidal estuary (4 m water depth) showing lateral channel migration in high detail. Gassy patches cut through the shallow stratification. (© RCMG Universiteit Gent).*

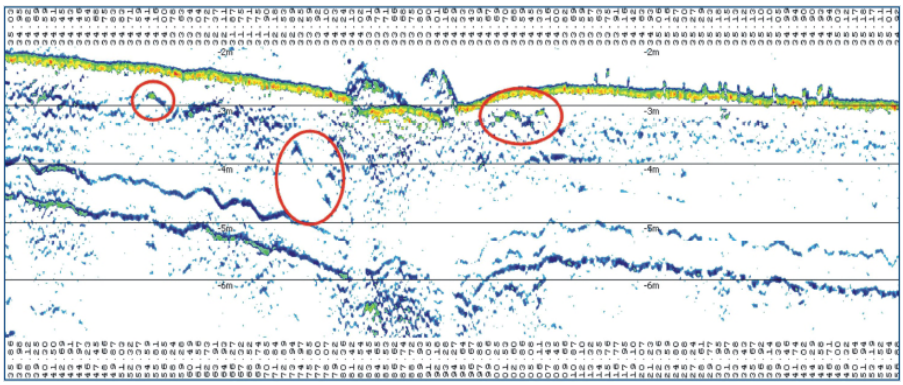

*Fig. 6 Parametric echosounder profile from a wreck site with several buried targets marked. Distance between two horizontal lines is 1 m.(© Innomar)*