Chirp subbottom profilers

Principle: Chirp systems sweep frequency intervals typically in the range 2-20 kHz. Since relatively low frequency/long wavelength signals have better penetration but lower resolution than relatively high frequency/short wavelength signals this allows for an optimal extraction of information from the bottom sediment. Pulse length and type as well as sweeps per second (8 shots per second at 1 knot is optimal for shallow water archaeology) can be adjusted.

Basic features: Penetration depth will highly depend on the sediments and improves with increasing depth. It can be up to 50 m into the seabed. Chirp systems have been used successfully to distinguish archaeological features at water depths as shallow as 0.5 m and are especially well suited to distinguish features with a restricted horisontal extension.

Resolution and horizontal precision: Resolution down to around 7.5 cm. Separate but adjacent transducers and hydrophones mounted in the 'fish' (transducer unit) allows for a higher precision in the horisontal positioning of features observed than if the reflected signal was picked up by a hydrophone array (streamer). A satellite antennae is installed near the fish to obtain a minimal offset. With a DGPS a positioning of observed anomalies a real precision of ± 25 cm can be obtained. This saves diving time when re-locating the anomalies for further investigation.

Platforms: Chirp systems can be operated from small vessels. The 'fish' (transducer unit) is normally attached to the side of the ship, and only a combined signal processing and recording unit is needed on board.

Advantages:

- Very high vertical and horisontal resolution
- Can be operated from very small vessels
- High potential for landscape reconstruction
- Can be used in very shallow water
- Small objects (dm range) can be detected

Disadvantages:

- Difficult penetration in hard sandy layers
- 2D image of the subbottom, no 3D
- Problems penetrating sediments with gas

Literature:

Grøn, O., Nørgård Jørgensen, A., Hoffmann, G. 2007: Marine Archaeological Survey by High-Resolution Sub-Bottom Profilers. ***Norsk Sjøfartsmuseums Årbok*** 2007, 115-144

Lafferty, B., Quinn, R. and Breen, C. 2006. A side-scan sonar and high-resolution Chirp sub-bottom profile study of the naural and anthropogenic sedimentary record off Lower Lough Erne, northwestern Ireland. Journal of Archaeological Science 33, 756-766.

Fig. 1 Typical Chirp towfish (© EG&G)

Fig. 2 Small boat with chirp towfish deployed on the side; the fender protects it against vibrations from the hull. © Ole Grøn.

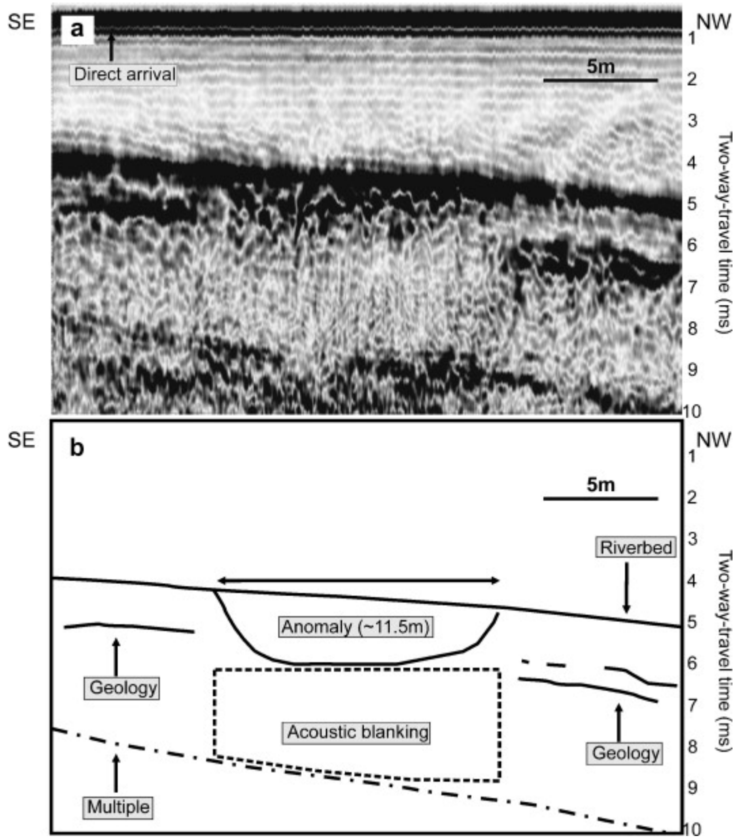

Fig. 3 Chirp profile of over the Grace Dieu wreck site (top: original data; bottom: seismic interpretation). © Ruth Plets et al.

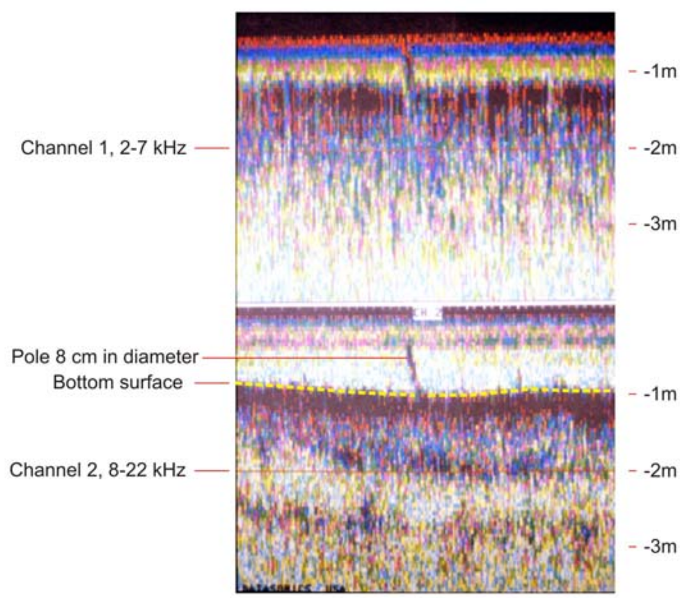

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Fig. 4 Chirp (Datasonics) profile of a wooden pole, 8 cm in diameter, standing up into the water and visible half a meter into the bottom. Top window: 2-7 kHz; botom window: 8-22 kHz. © Ole Grøn..

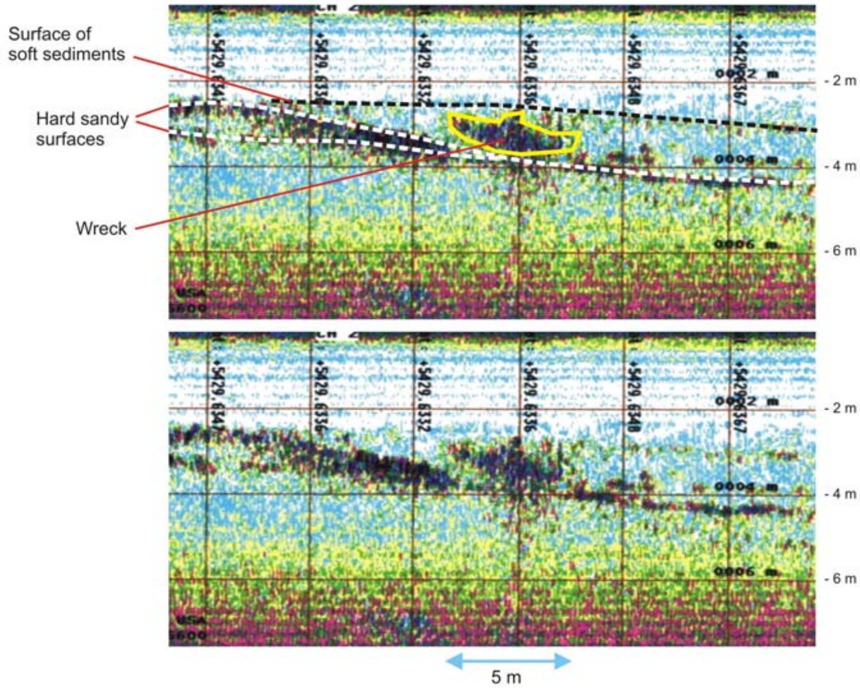

Fig. 5 Chirp (Datasonic) profile through a small buried wooden wreck (1200 A.D) in Haithabu.
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