

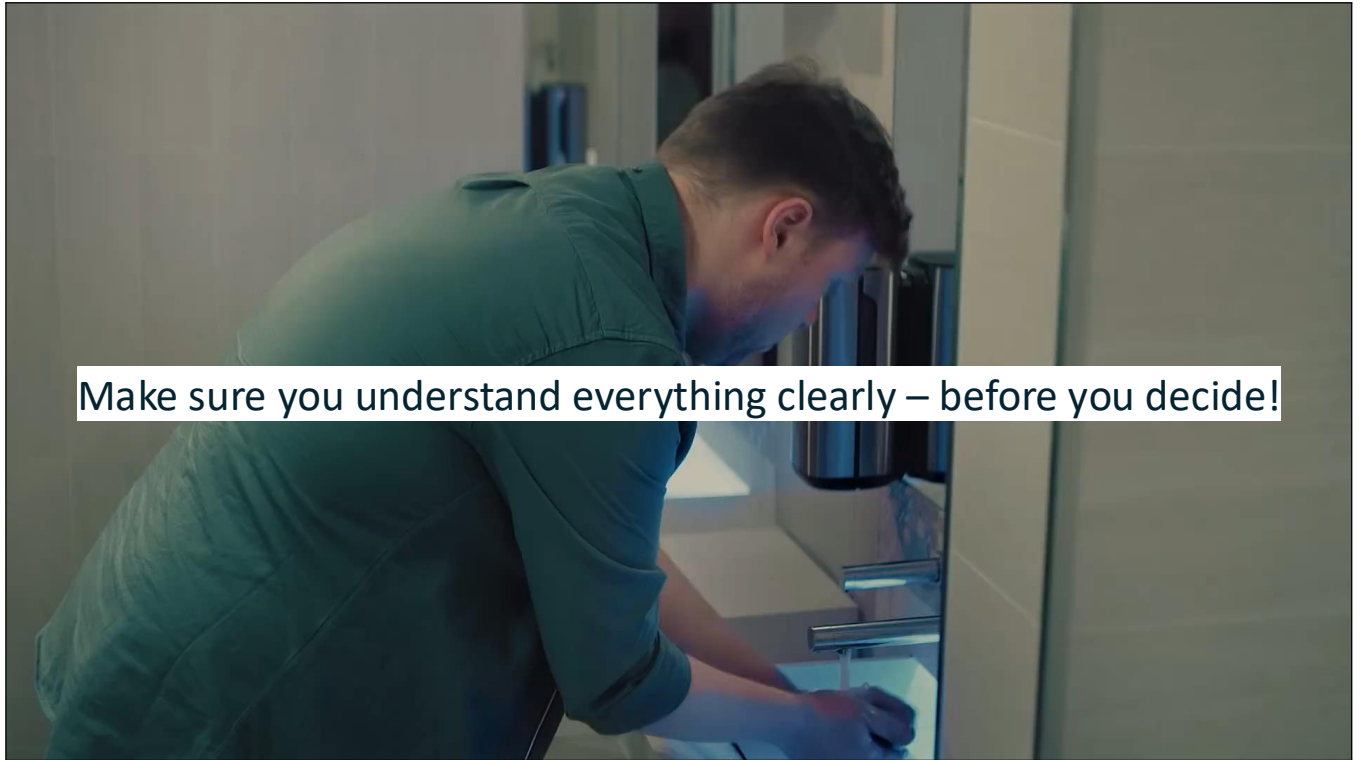
# Proceedings of the 11<sup>th</sup> Workshop “Seabed Acoustics”, Presentation P12:

## Layered Media Detection — A novel approach to efficient mapping in areas with fluid mud

Uni Bull  
Norbit ASA, Norway

5<sup>th</sup> November 2025



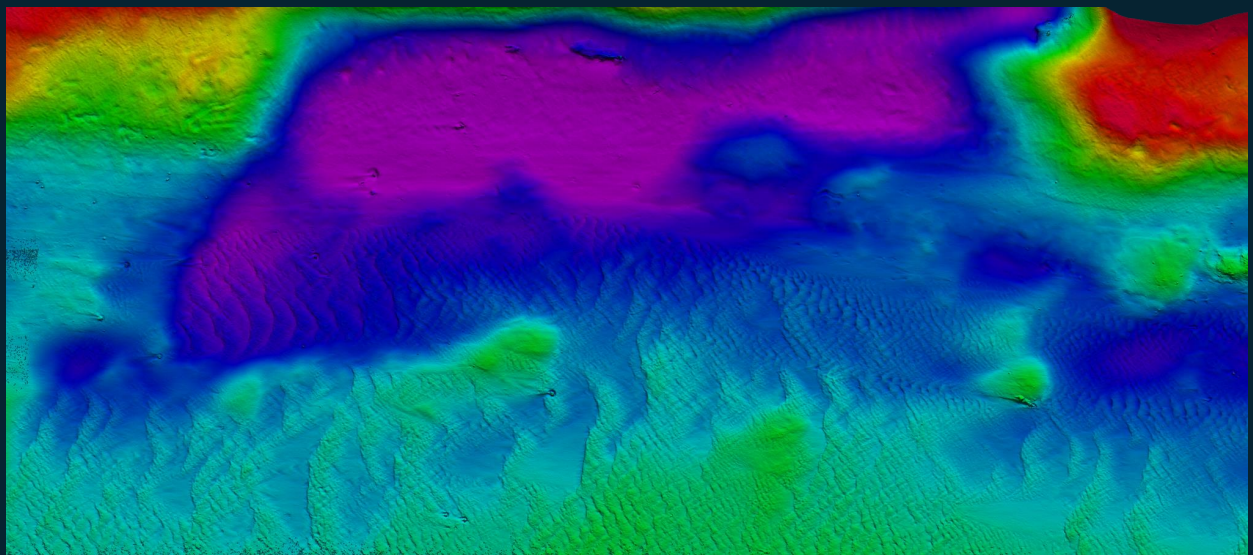


**Seafloor**  
**Fluid mud / fluff**  
**Acoustic challenges**  
**Navigable depth**  
**LMD – decision making tool**

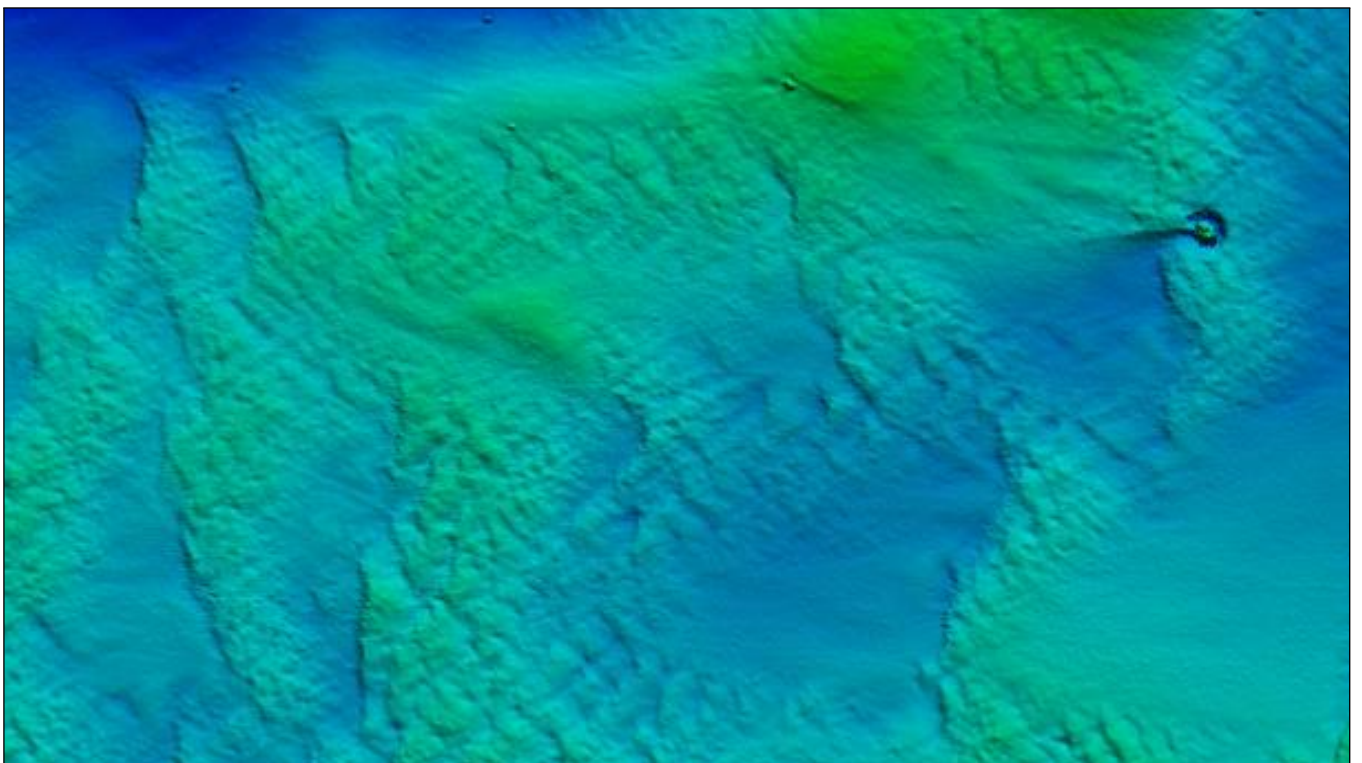
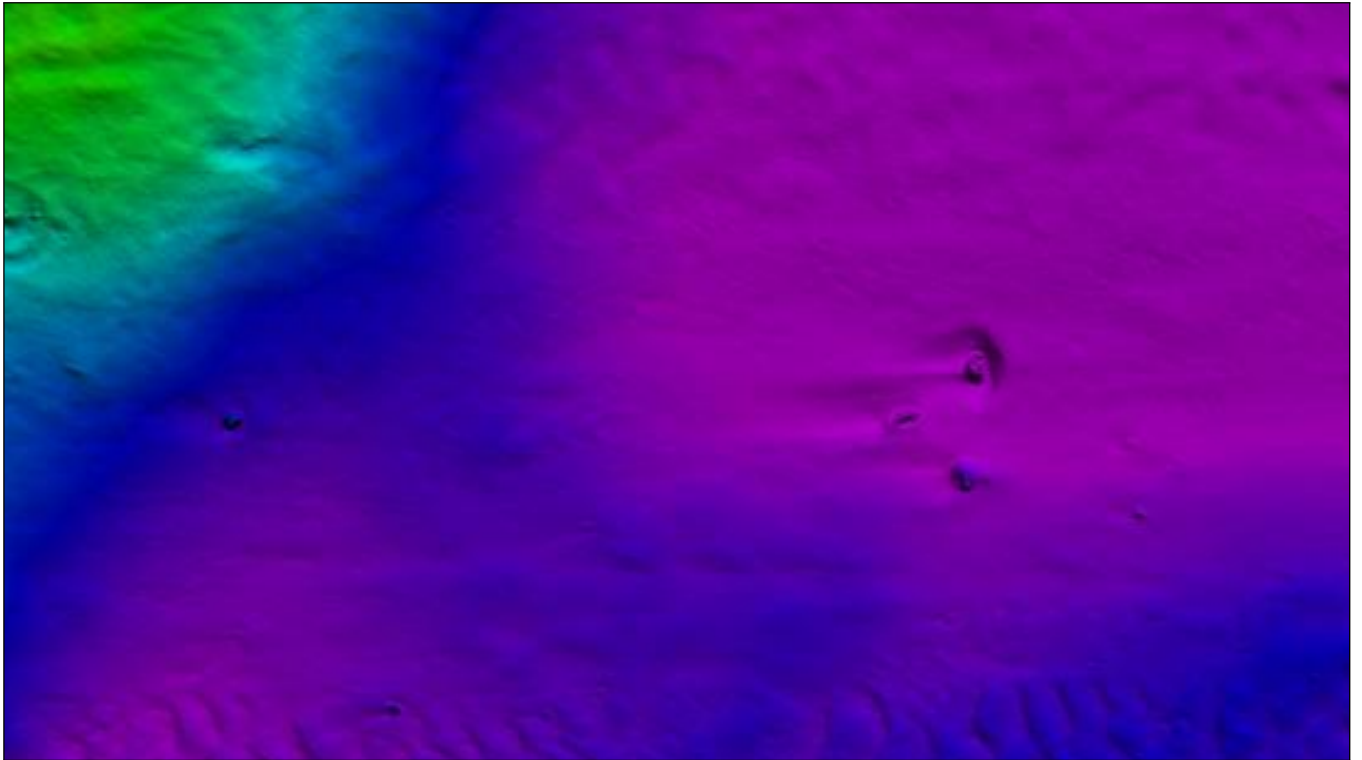
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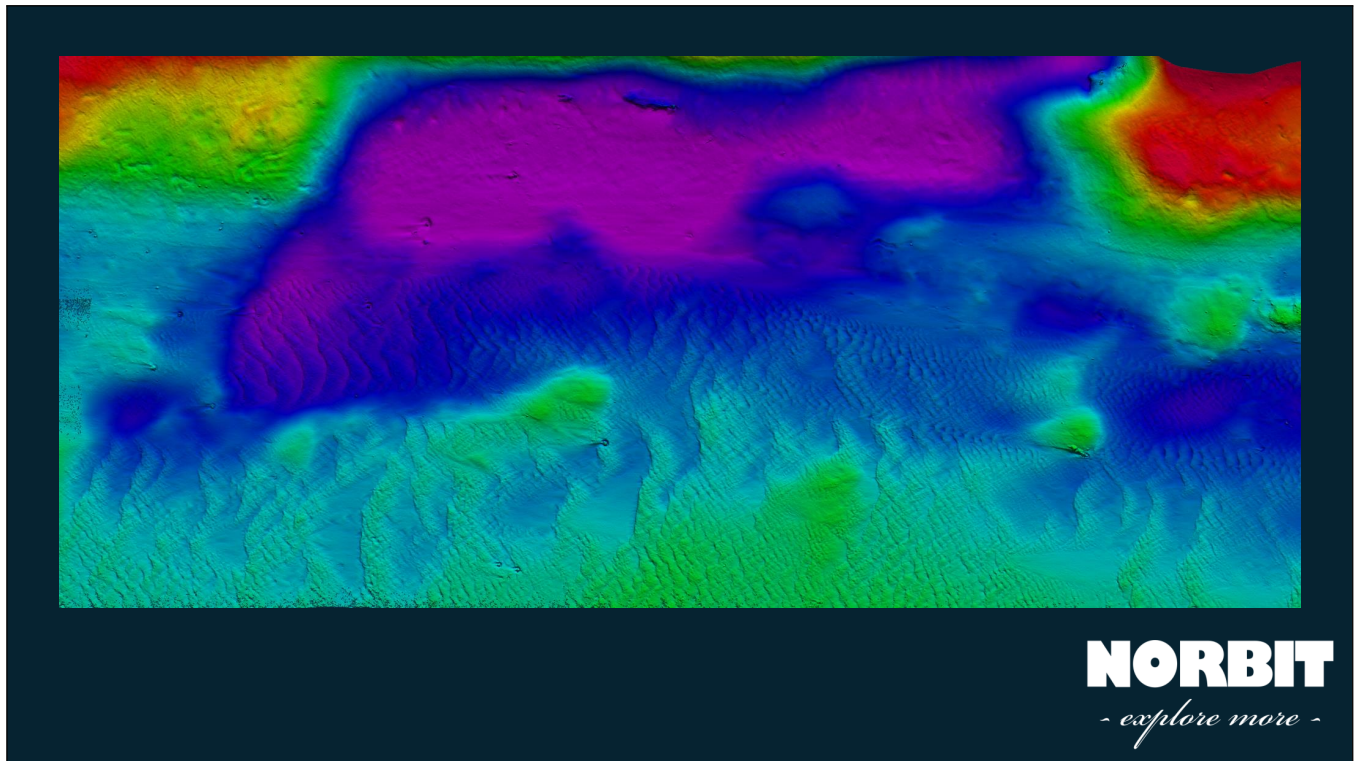
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LMD

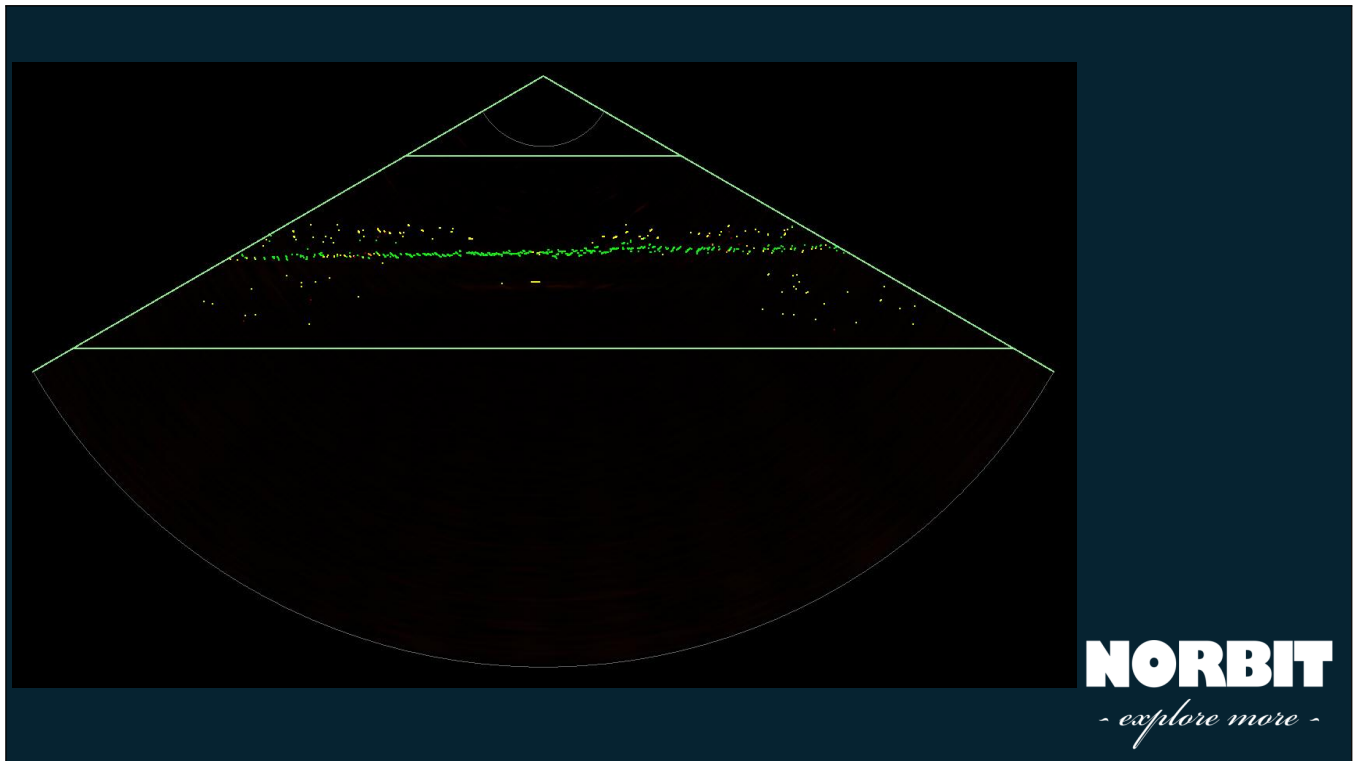
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Seafloor  
Fluid mud / fluff  
Acoustic challenges  
Navigable depth  
LMD

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Mud is not just mud...



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What is fluid mud?

Water with silt  
Flocculated mud  
Fluid Mud  
Firm Mud



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Behaviour  
Maneuverability

Depth measurements

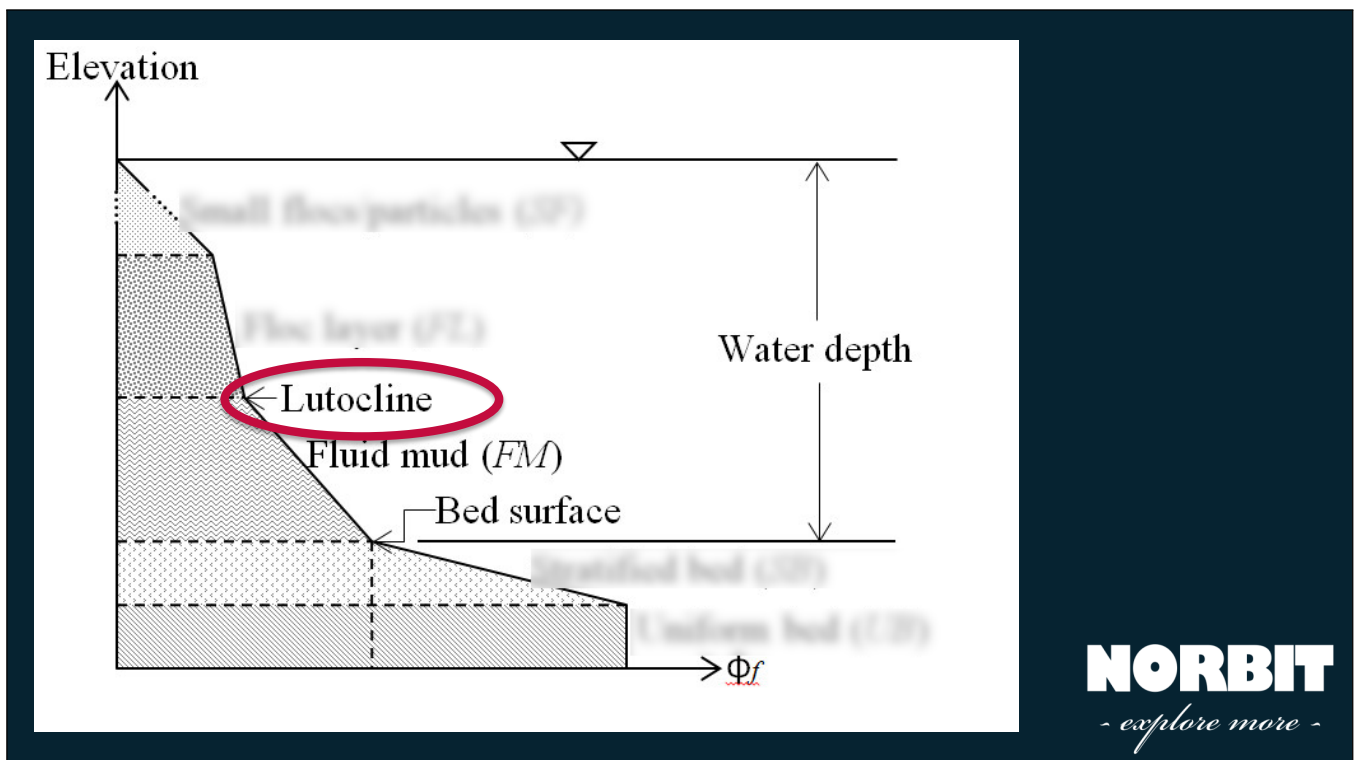
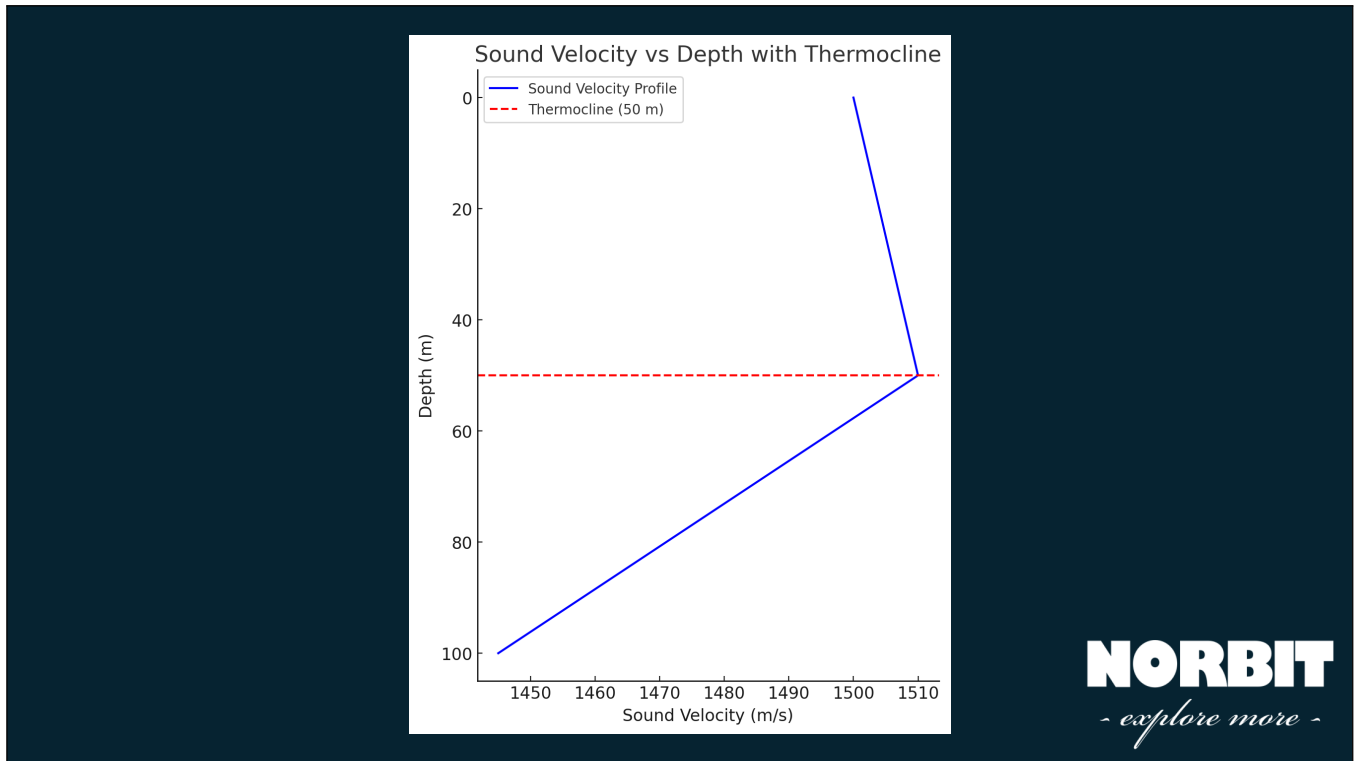
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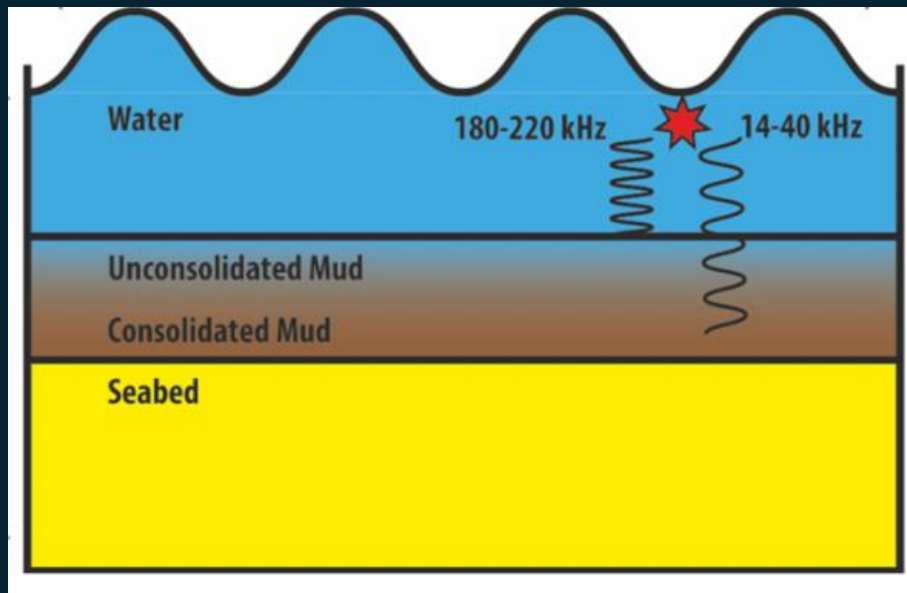
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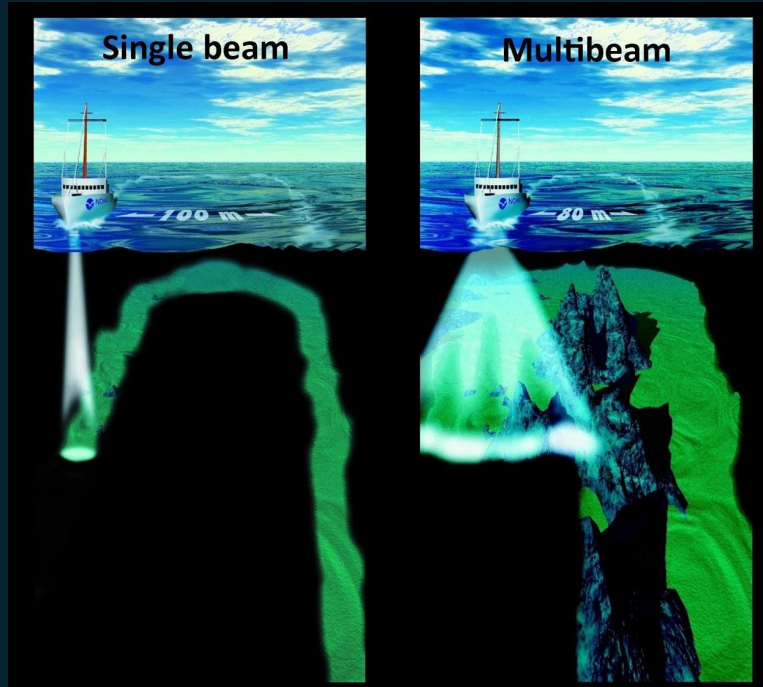
Lutocline  
Thermocline

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**Single beam**

100 m

**Multibeam**

80 m

A1		<p>Full area search undertaken. Significant seafloor features detected and depths measured</p>
B		<p>Full seafloor coverage not achieved; uncharted features, hazardous to surface navigation are not expected but may exist</p>

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Surveying for a CATZOC A1 navigable bottom in the presence of fluid mud

## Mapping through fluid mud


By Dr Pawel Pocwiardowski, NORBIT

The presence of suspended sediments in water bodies presents significant challenges for the dredging industry. Existing methods to determine nautical depths are intrusive single point methods relying on in situ density or shear strength measurements<sup>1,3</sup> or low-frequency single-beam echosounder recordings<sup>1,2</sup>. The use of single-beam echosounders is however systemically problematic as they are not practical in satisfying the CATZOC A1 coverages required for contemporary electronic navigational charting.

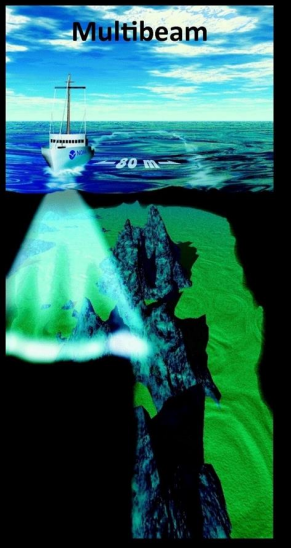
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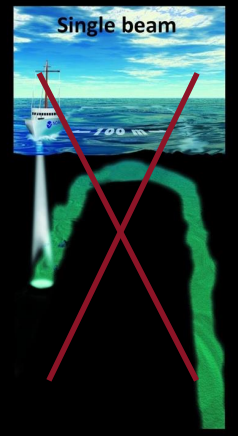
A1



Full area search undertaken.  
Significant seafloor features detected and depths measured



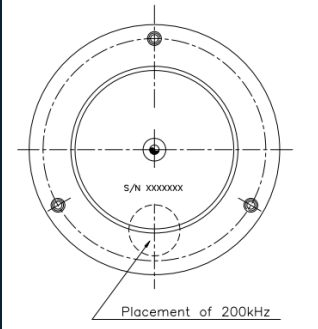


Multibeam



Single beam

Challenge

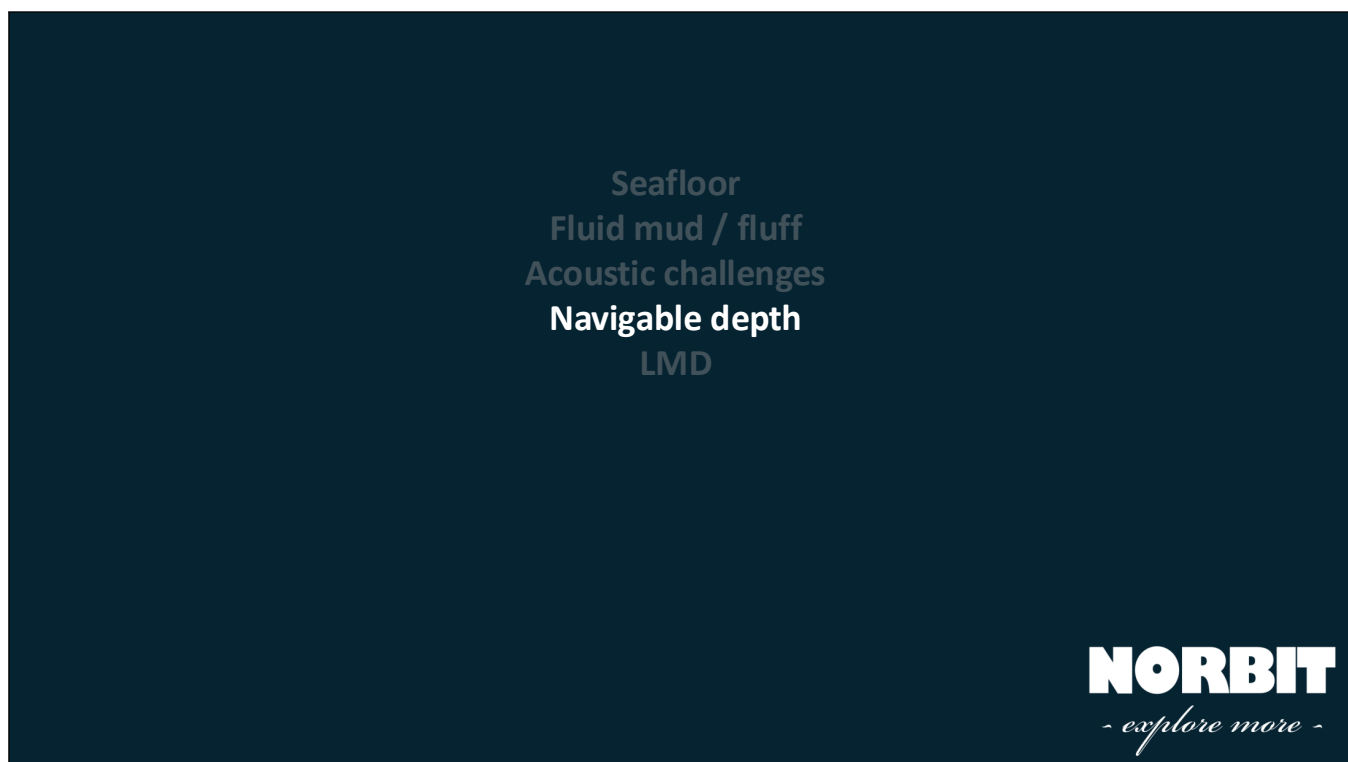
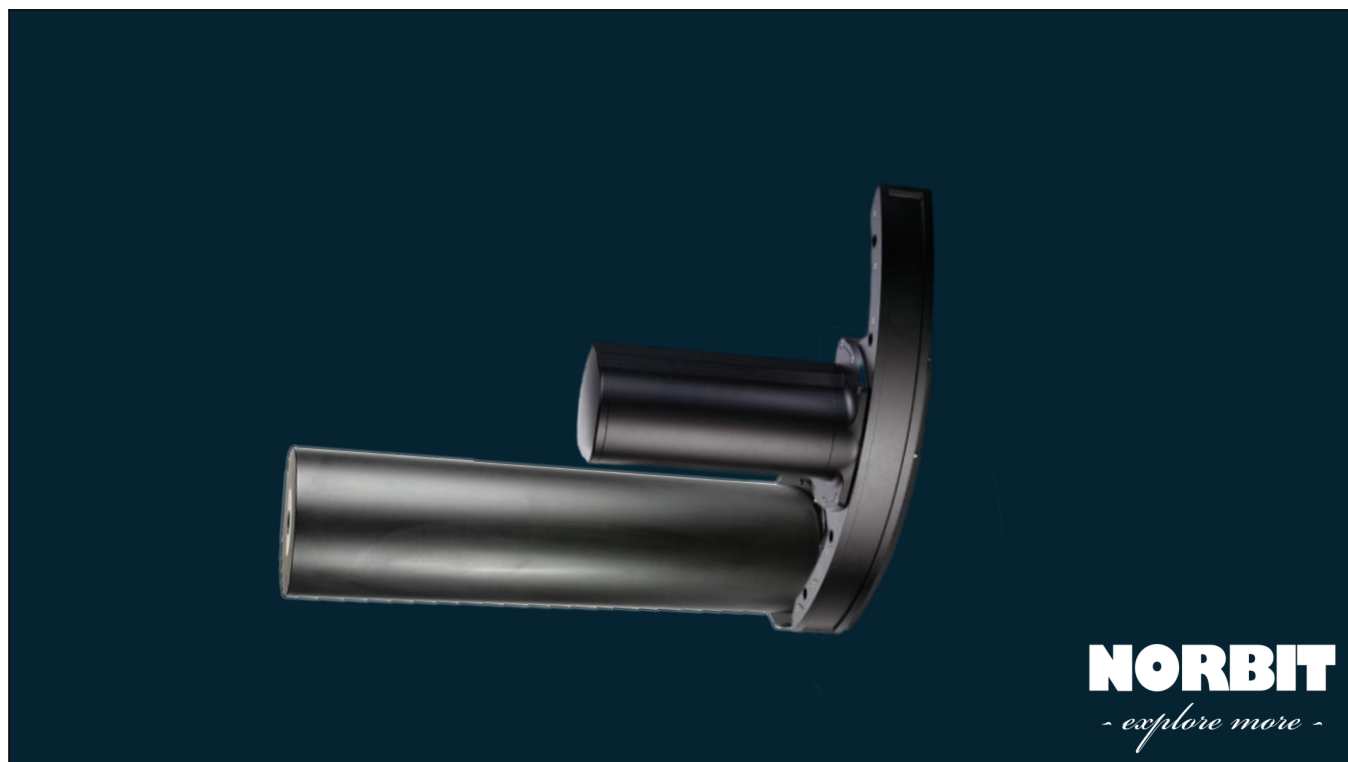
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S/N XXXXXXXX

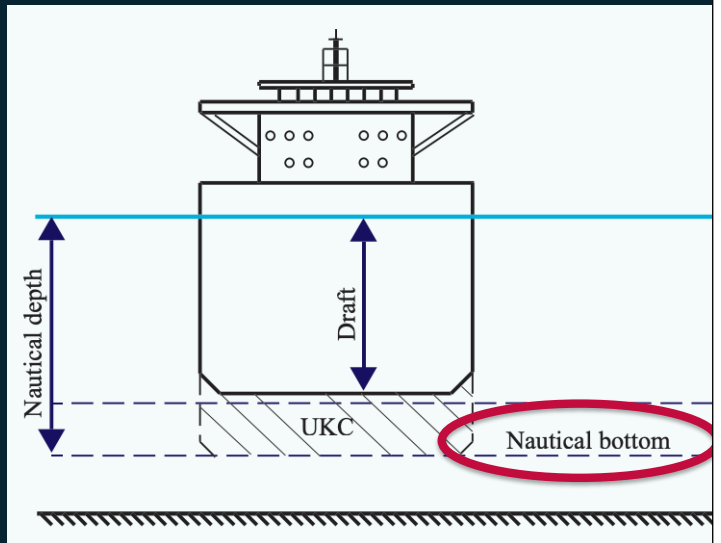
Placement of 200kHz

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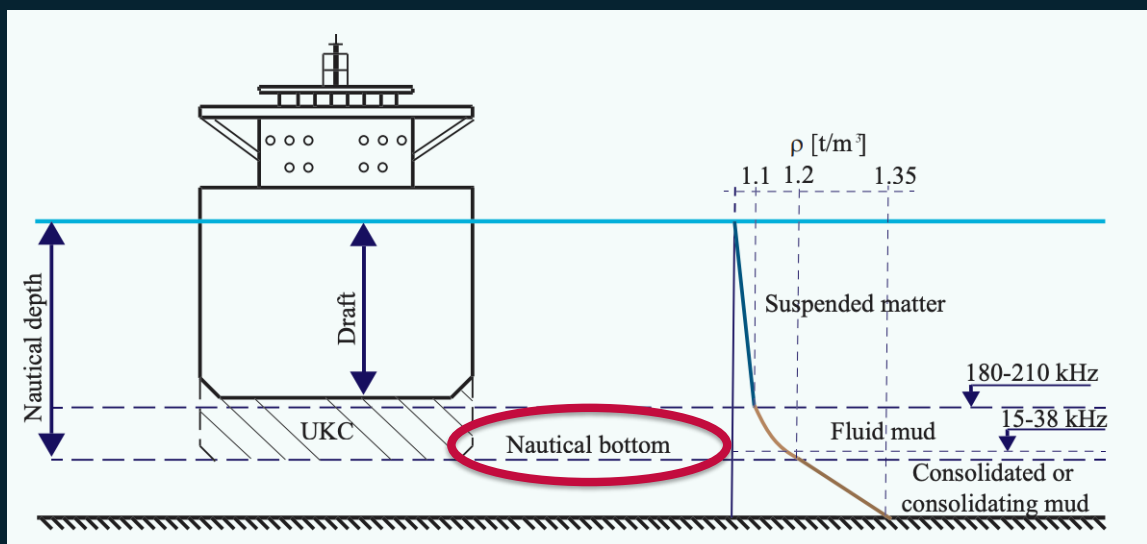


### Under Keel Clearance

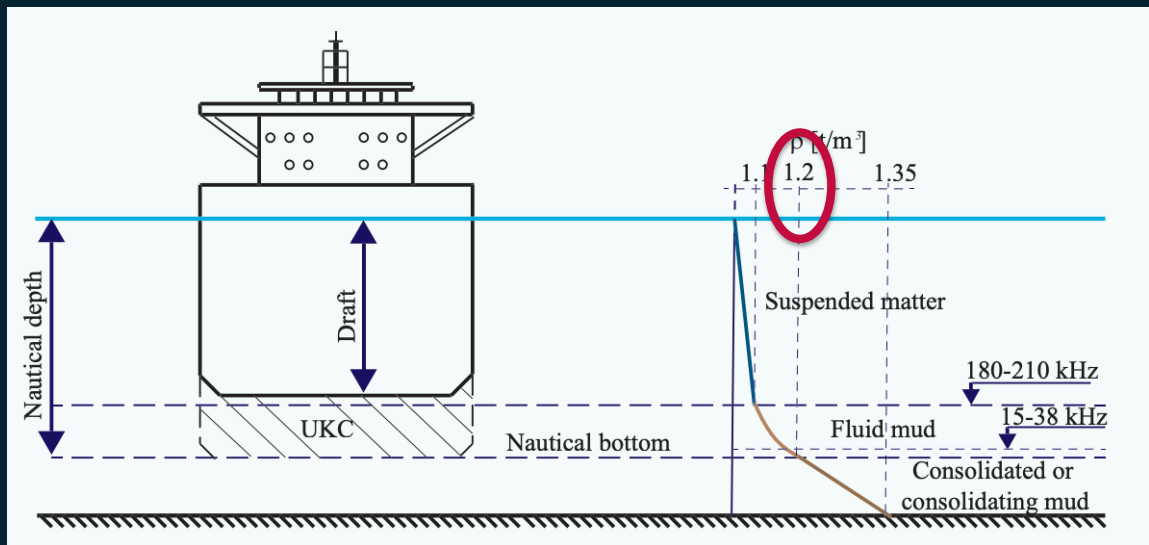
- Restrict draft
- Maintain depth



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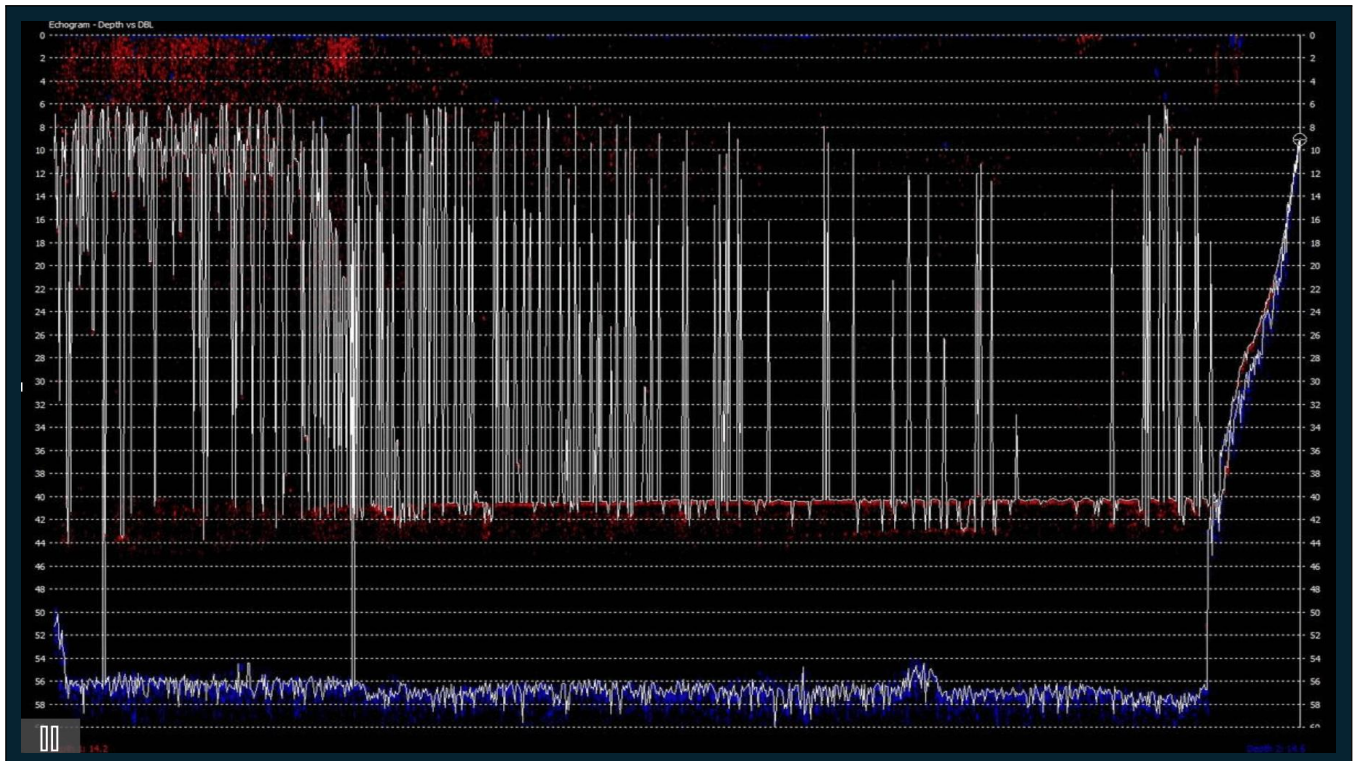
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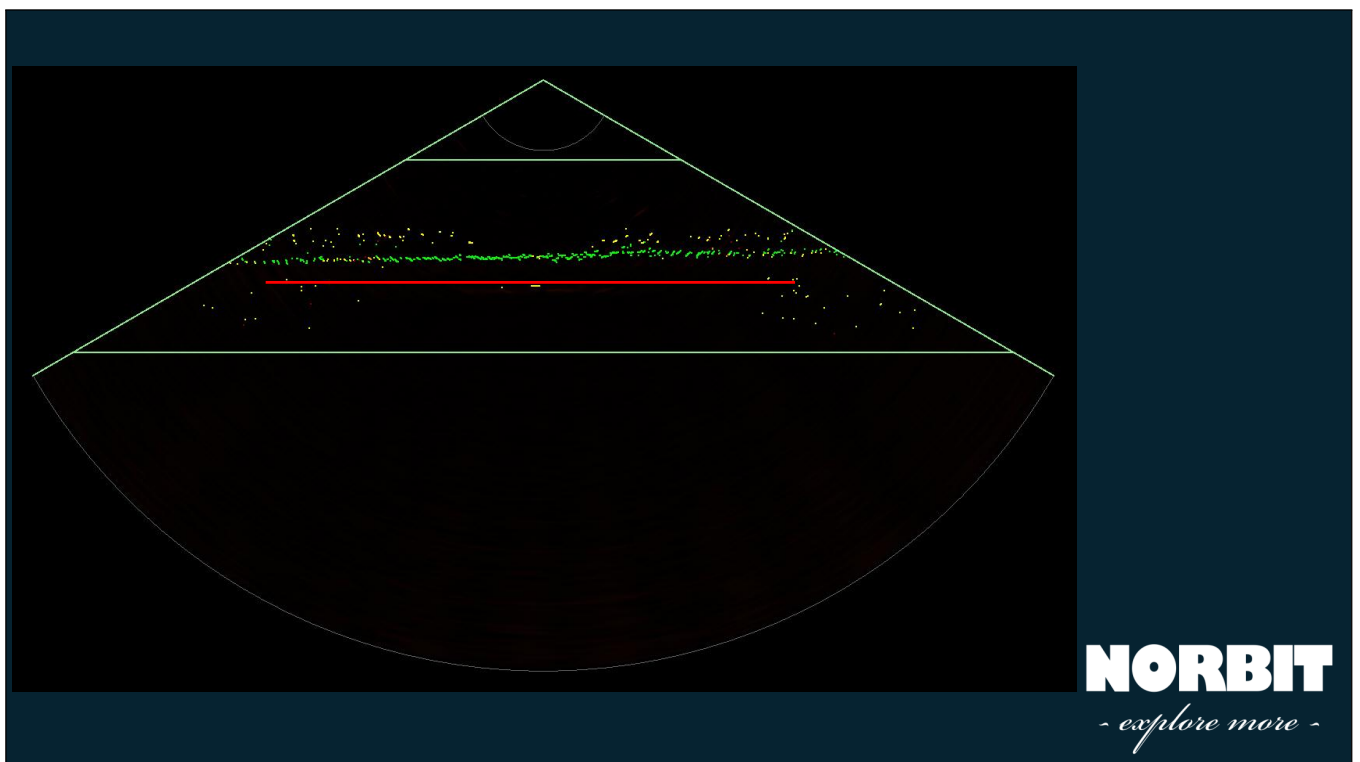
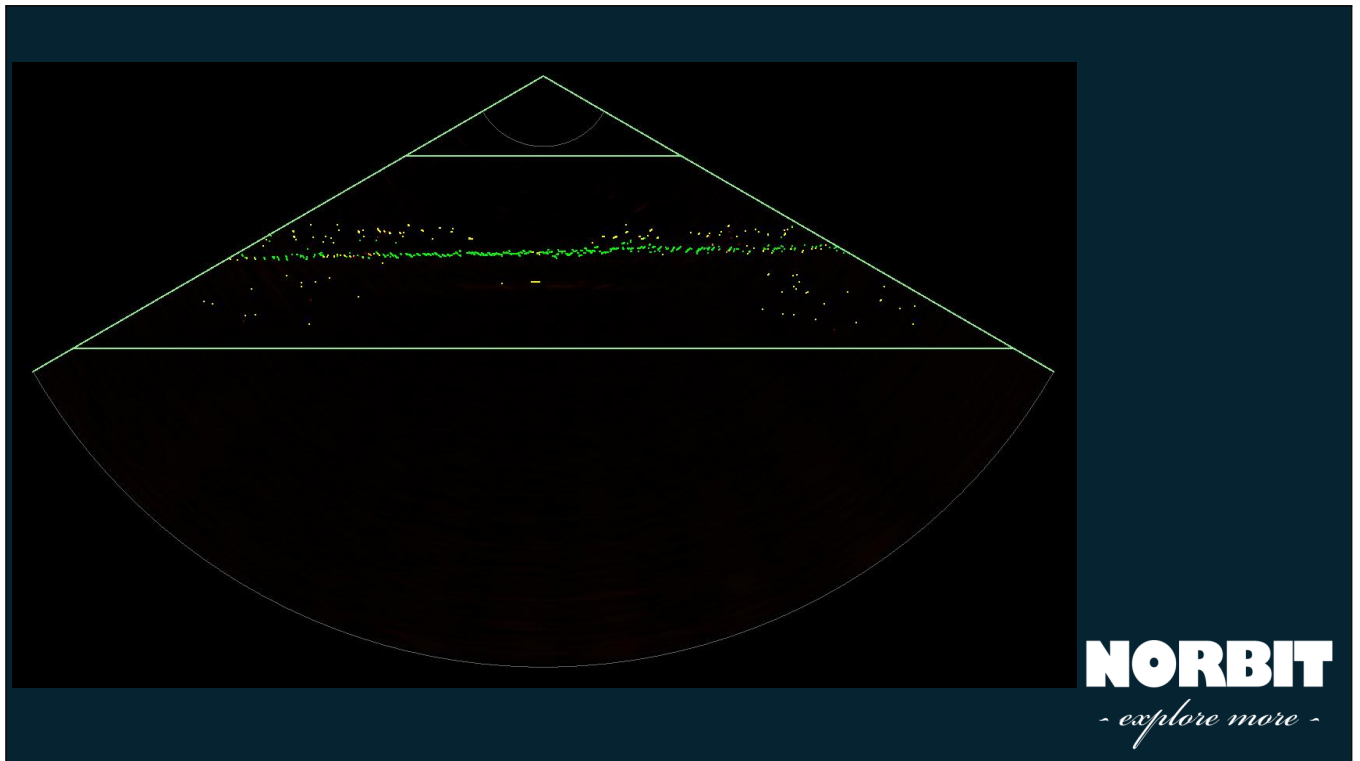
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Seafloor  
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**LMD**

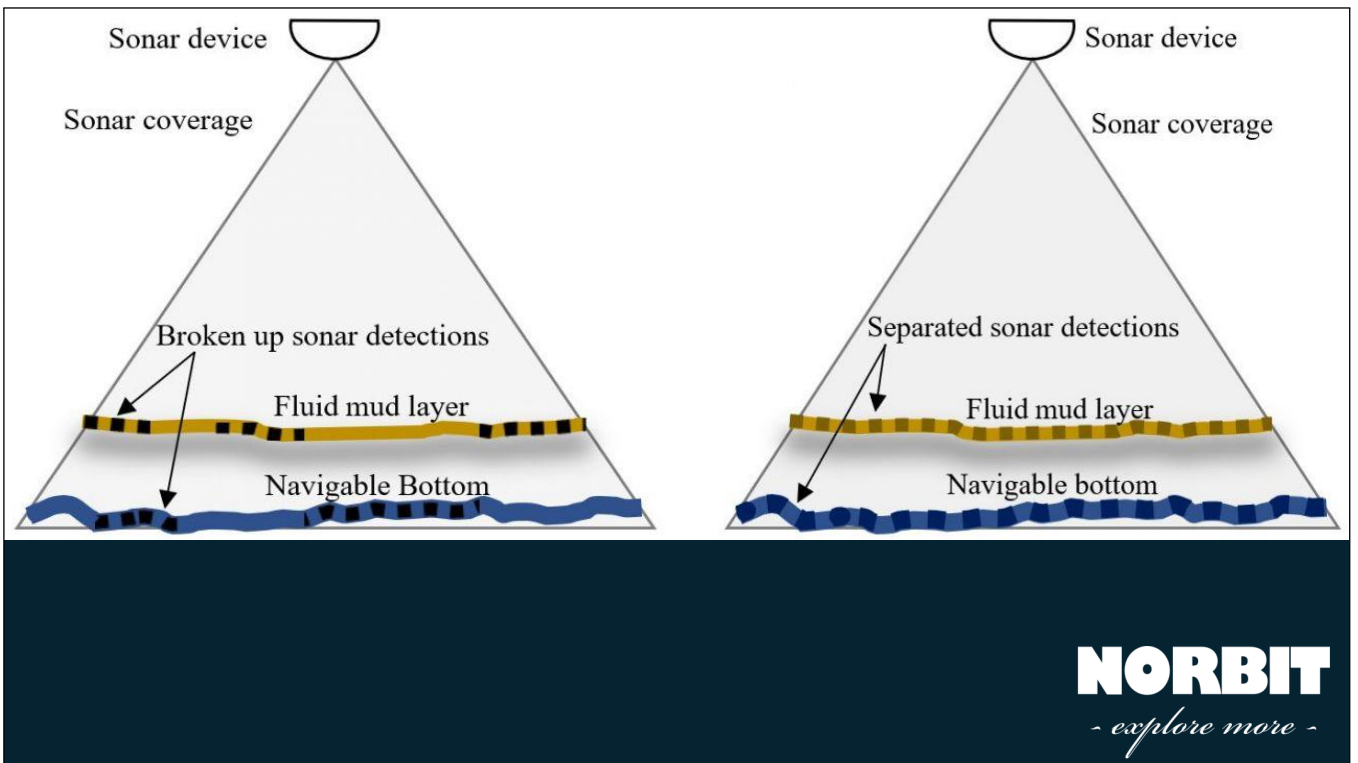
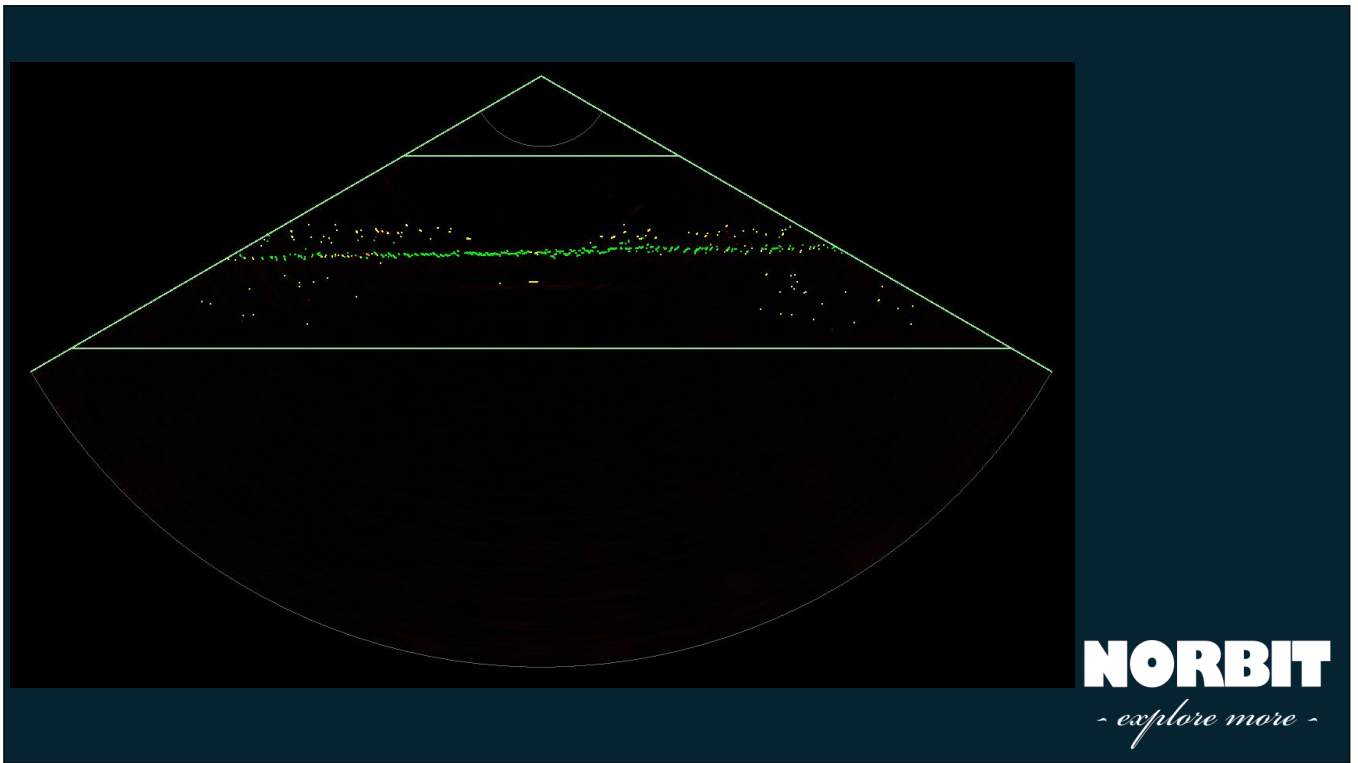
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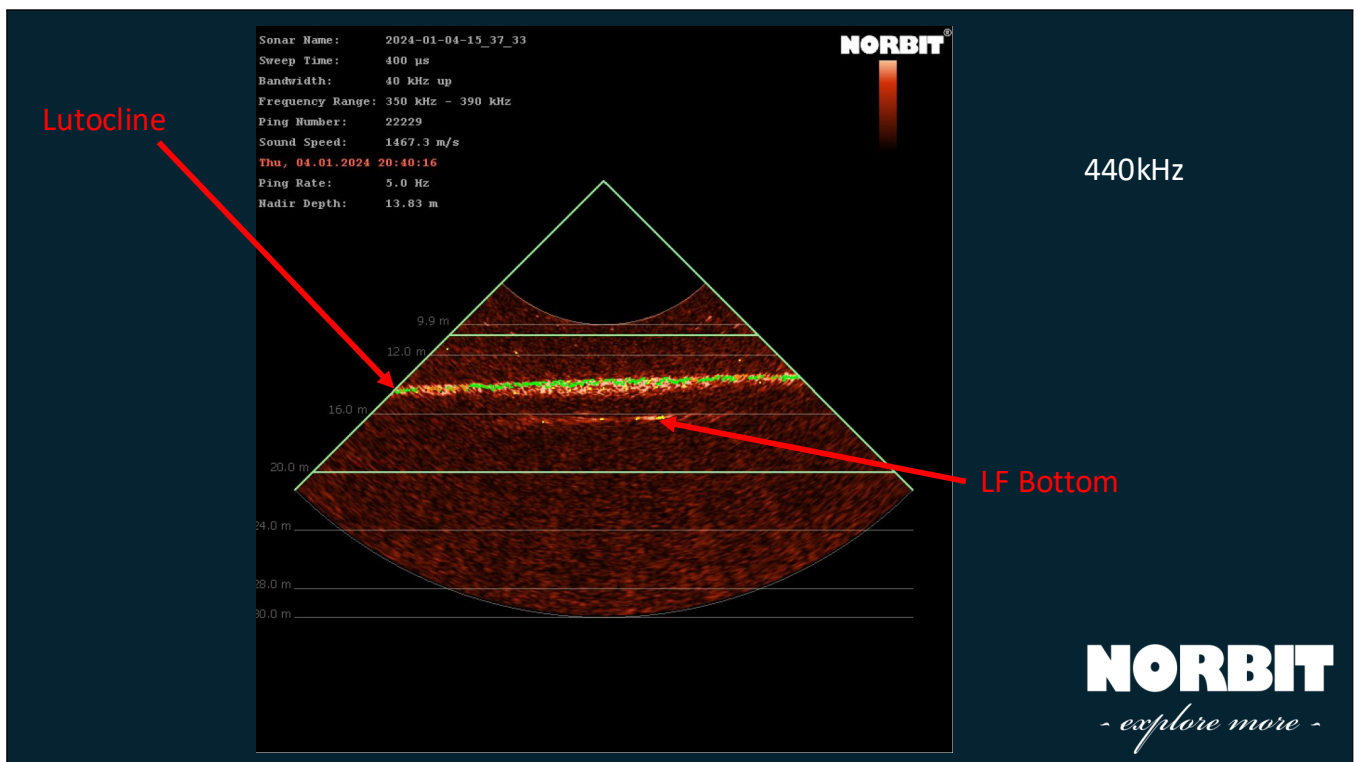
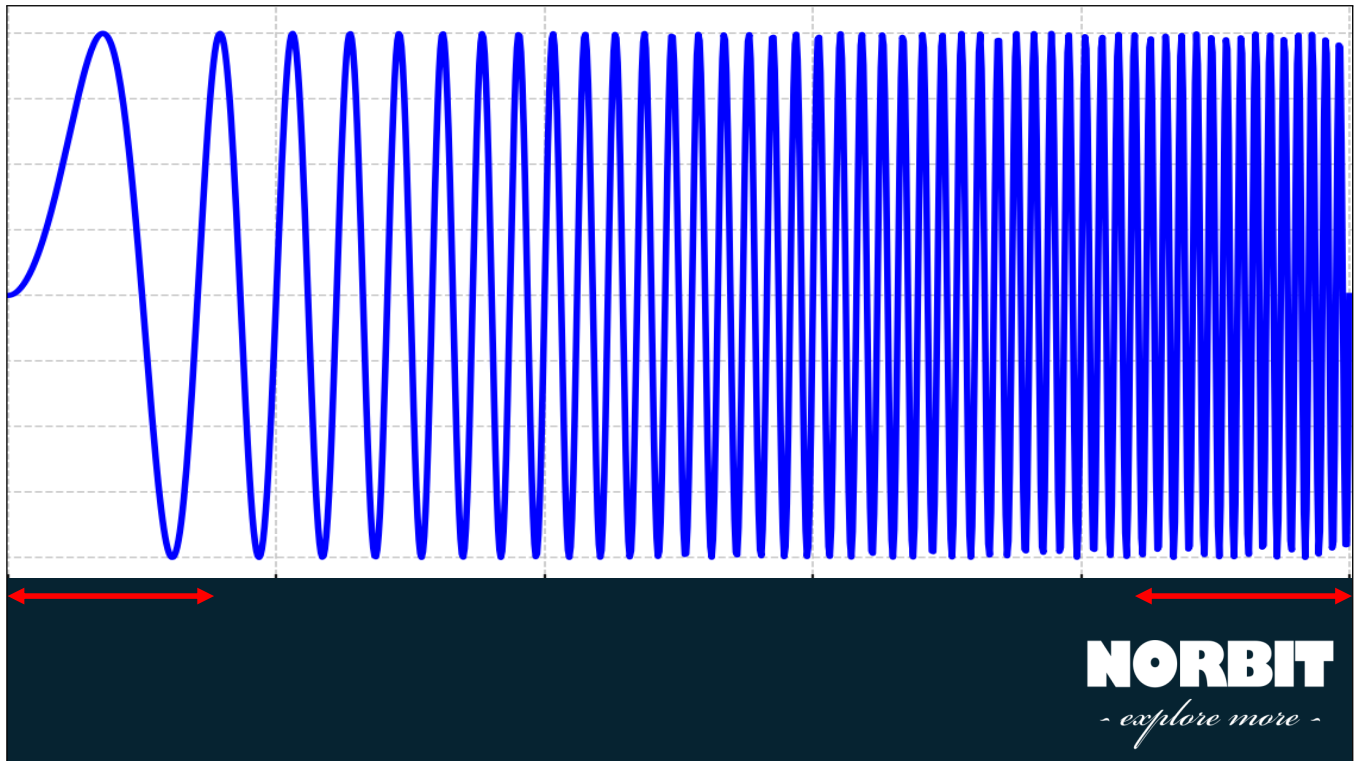


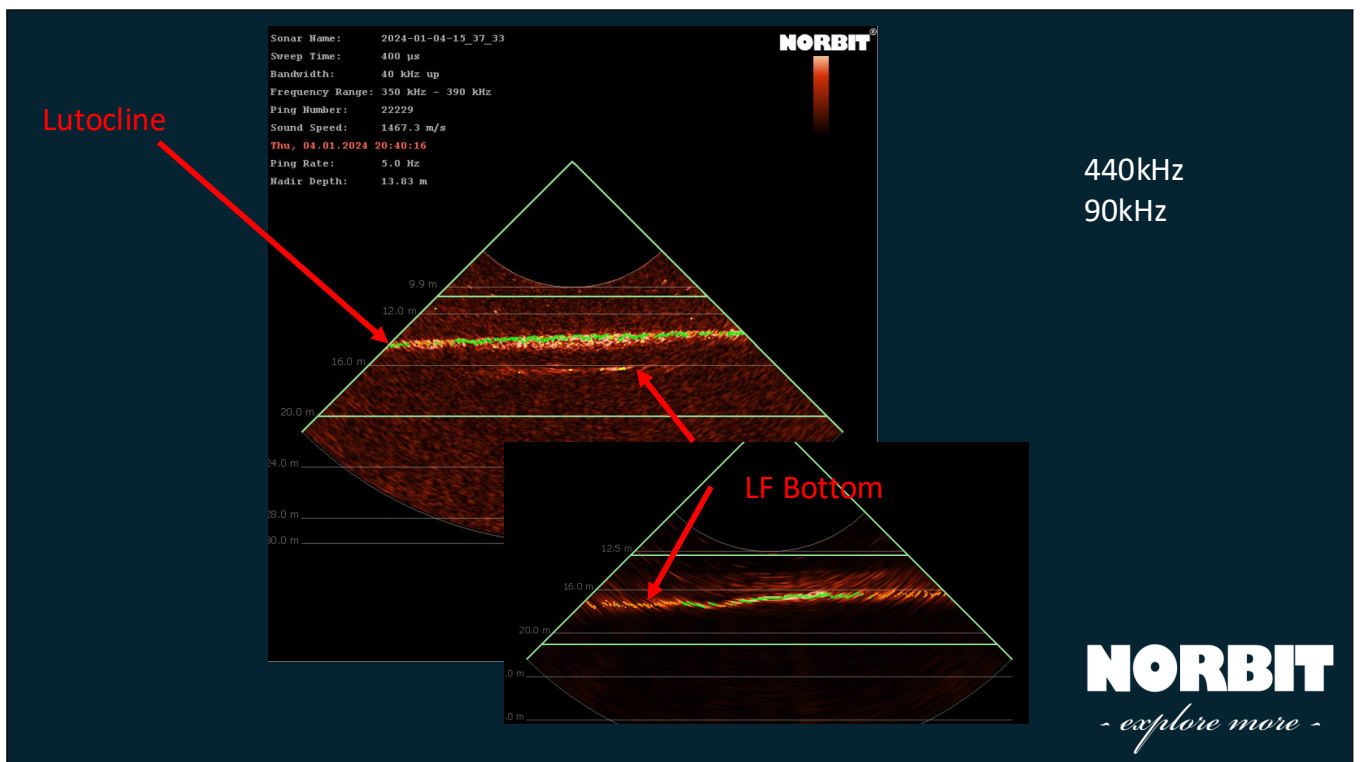
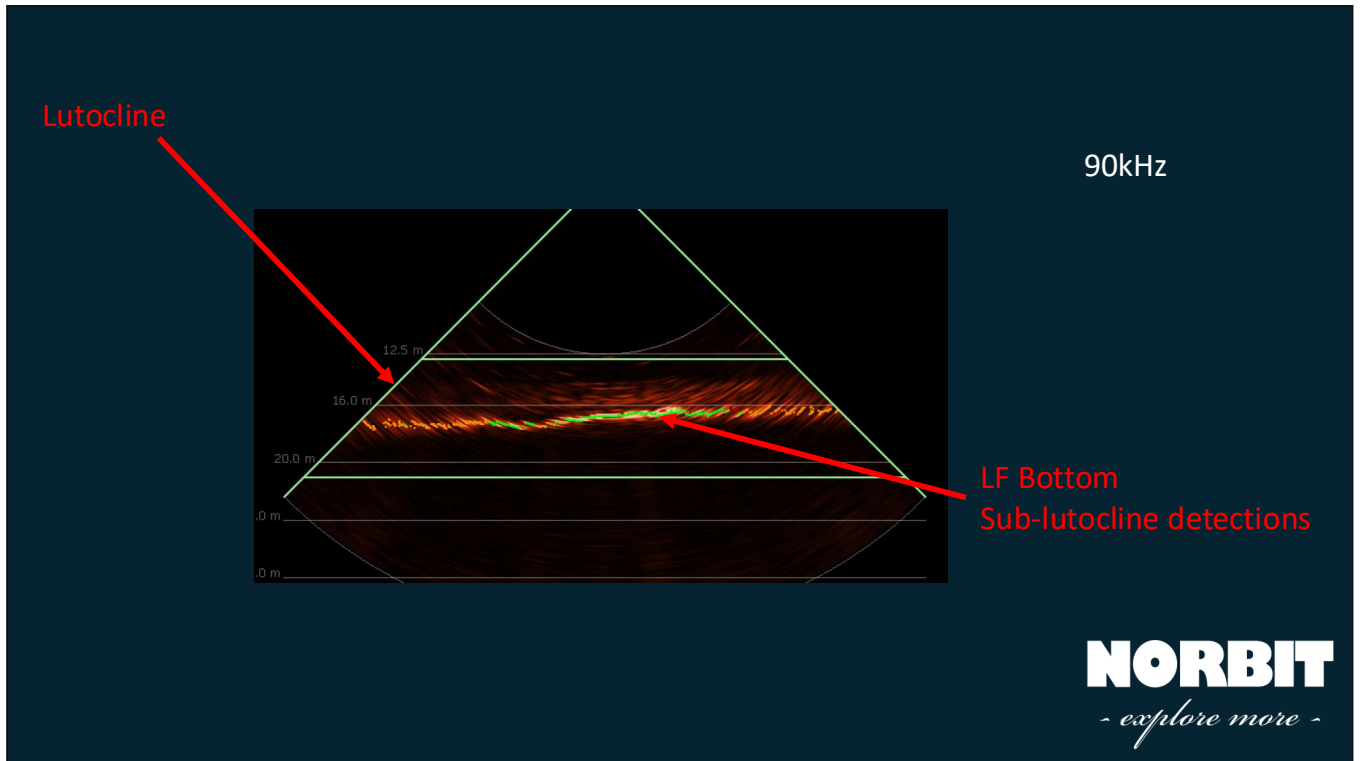
The image is a composite graphic. At the top, the text "Single beam" is displayed in white. Below it is a photograph of a white research vessel on the ocean surface, with a blue double-headed arrow indicating a 100 m distance. A white beam of light is shown originating from the vessel and pointing down towards the seabed. Below the photograph, a green 3D visualization shows the seabed profile as a curved, elongated shape. In the bottom right corner, the logo "NORBIT" is written in large, bold, white capital letters, with the tagline "- explore more -" in a smaller, italicized font below it.

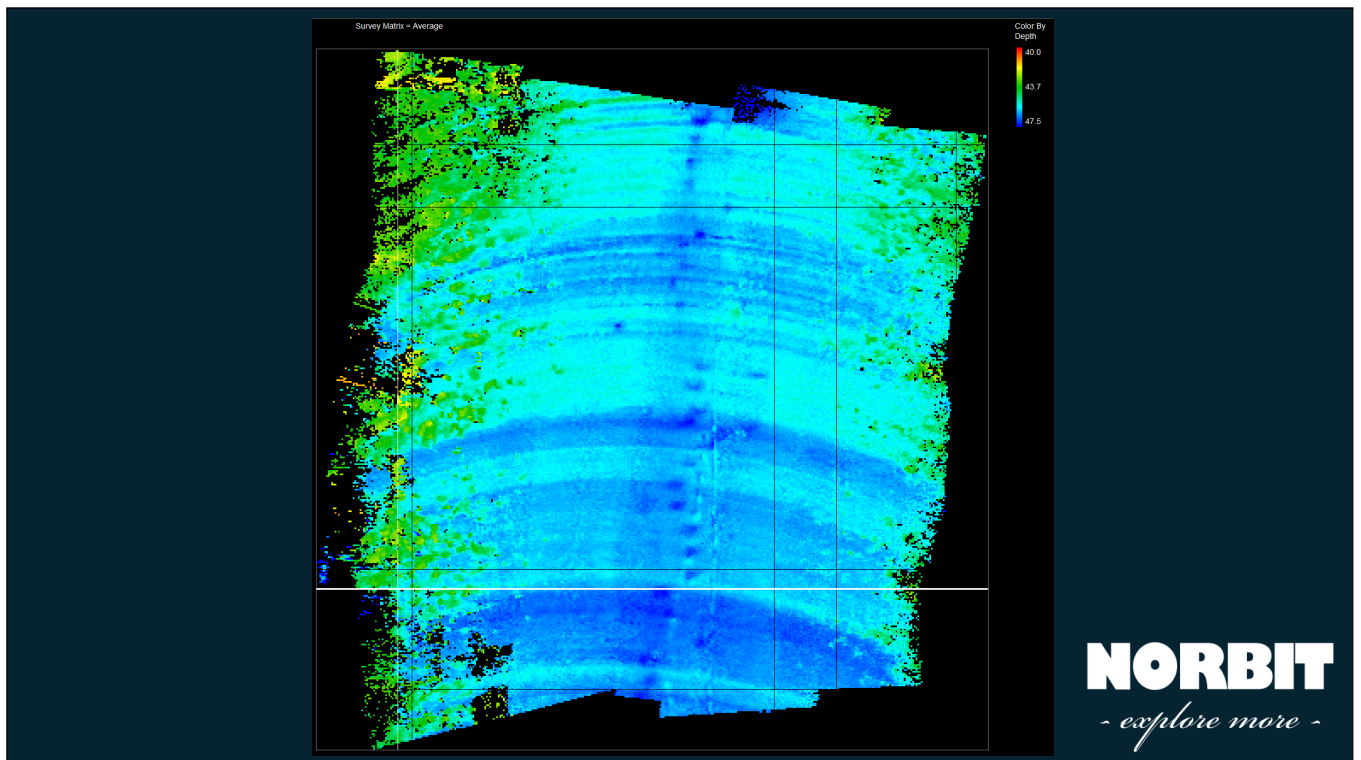
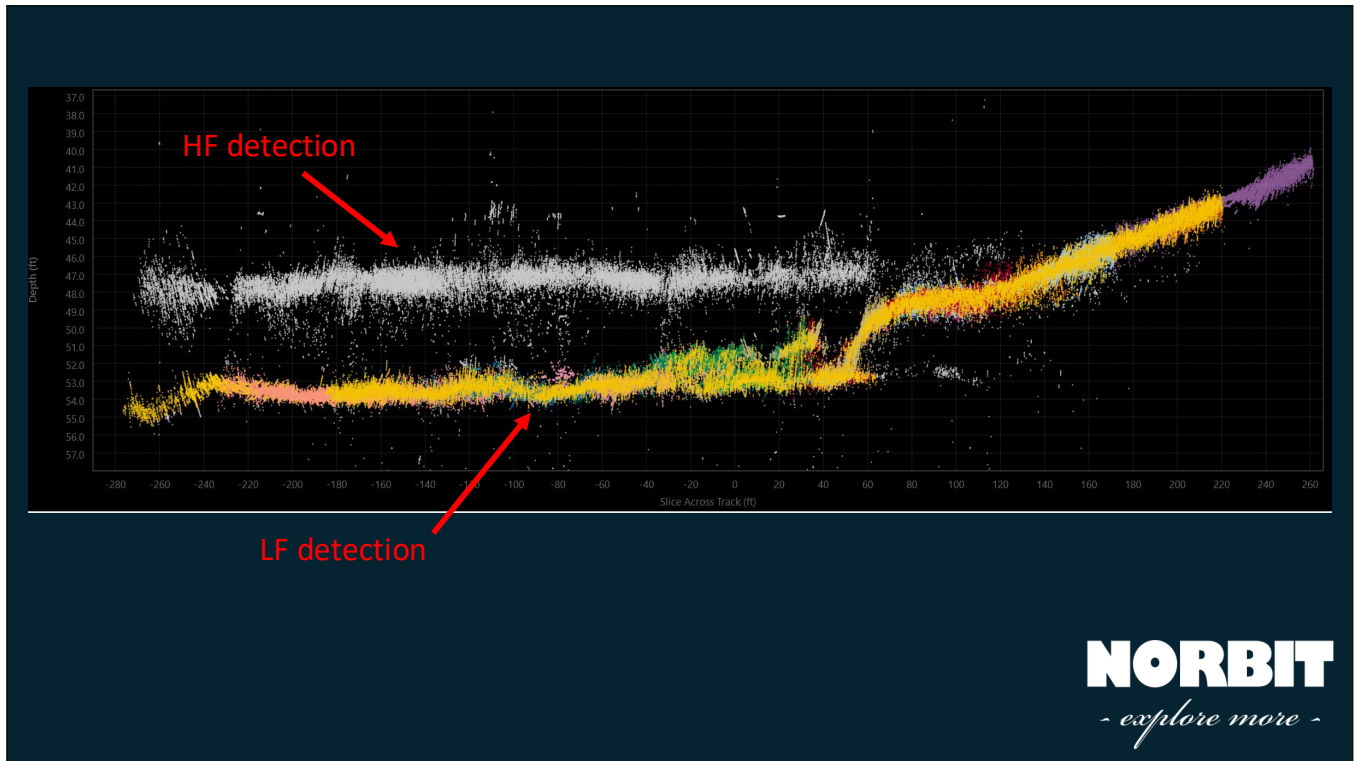


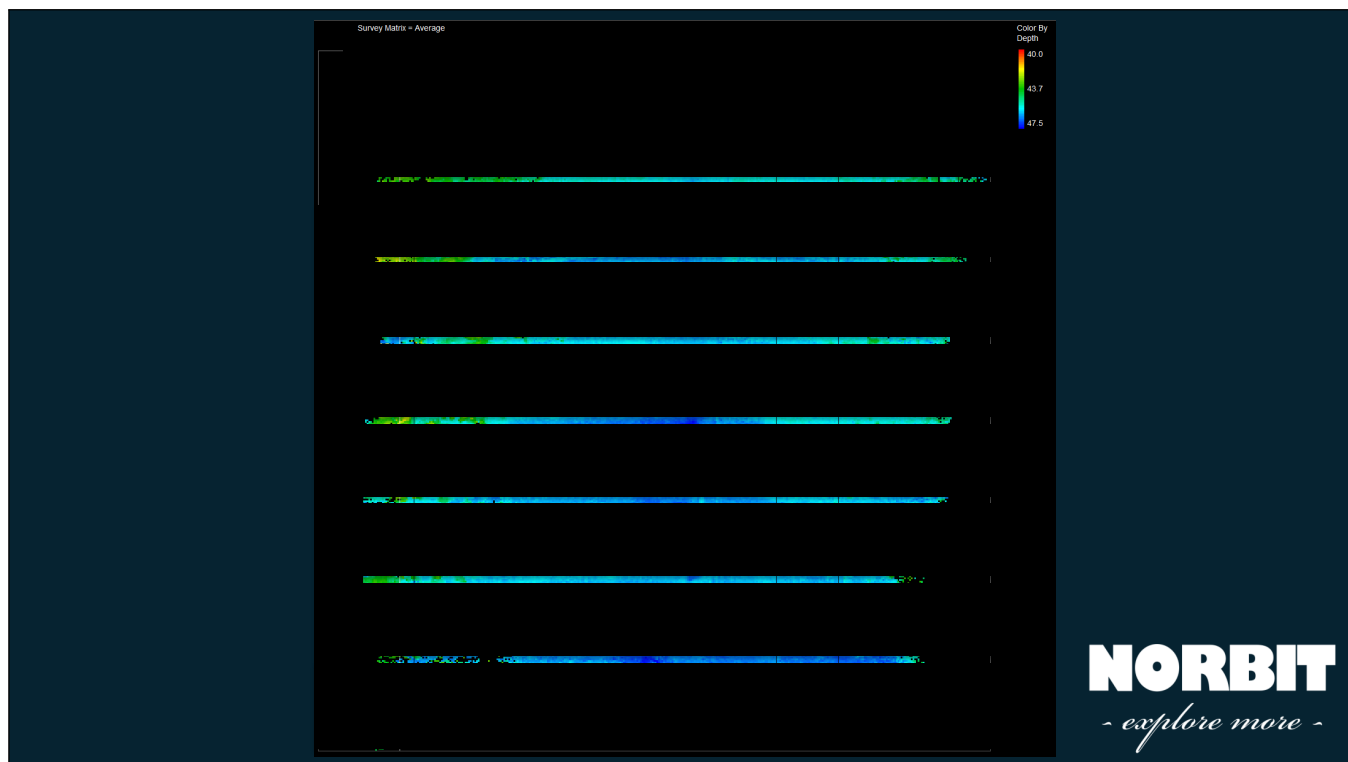






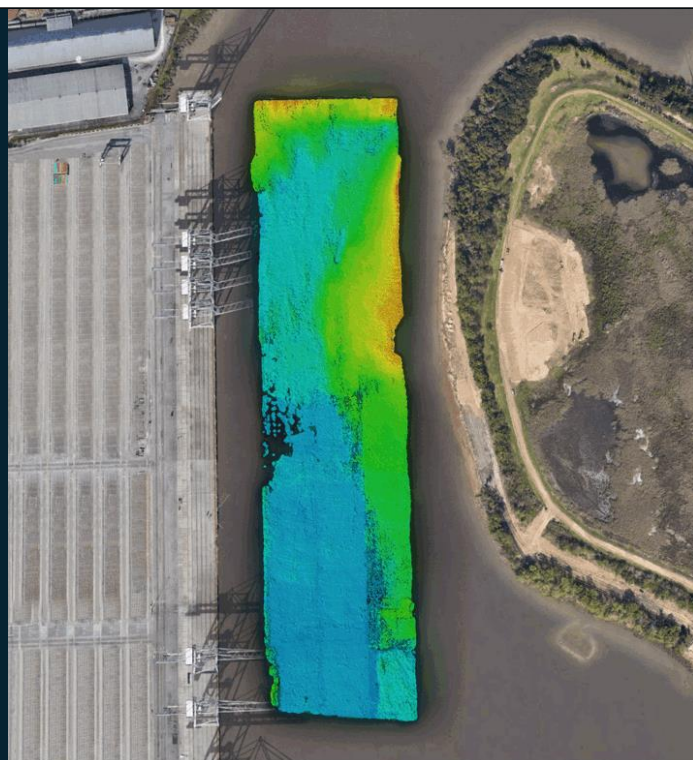


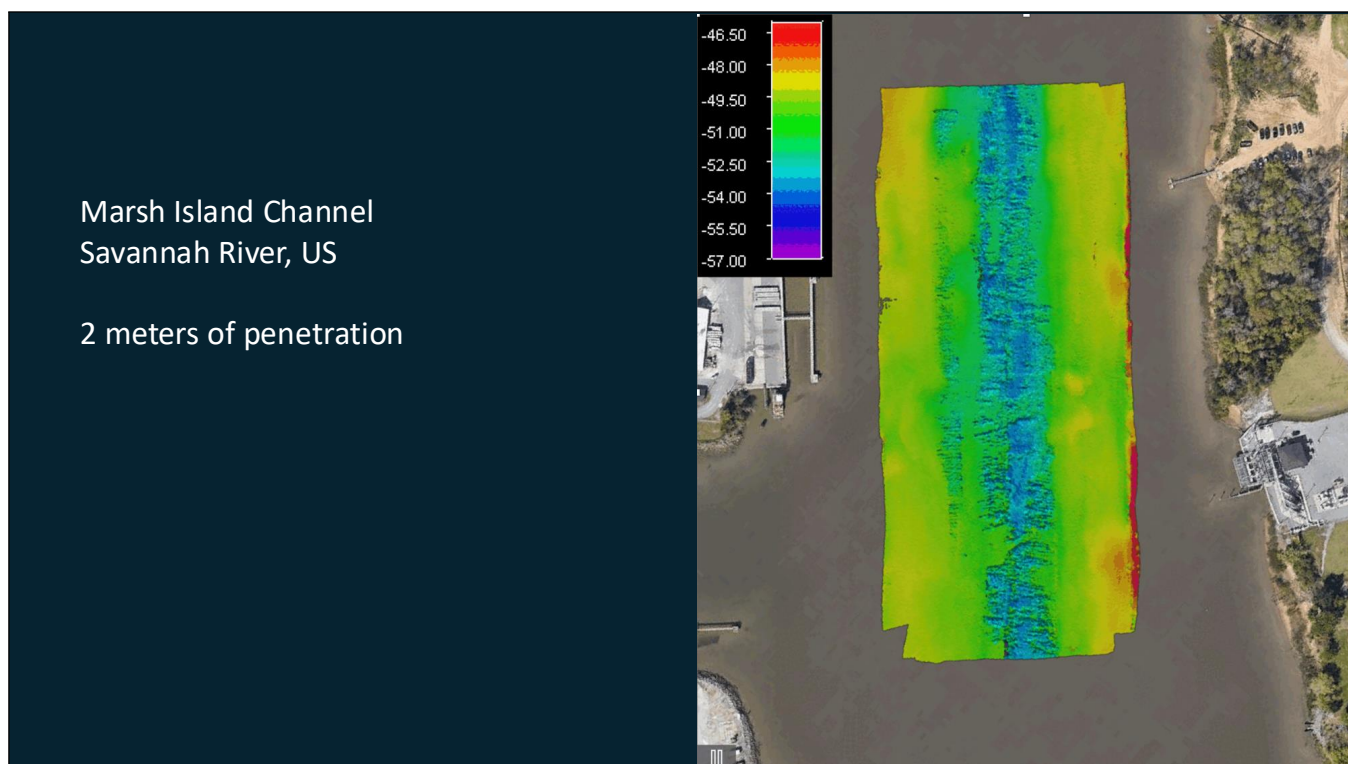
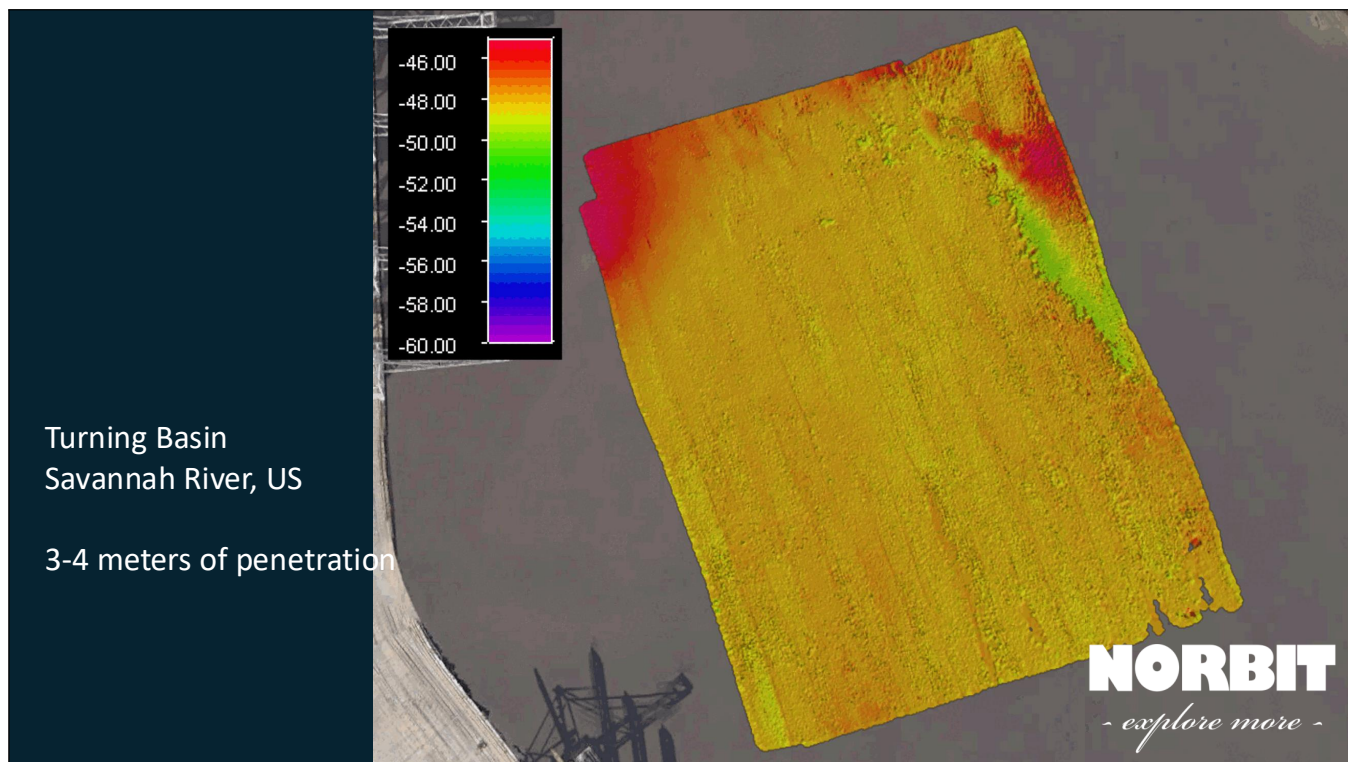




King's Island Channel  
Savannah River, US

3-4 meters of penetration





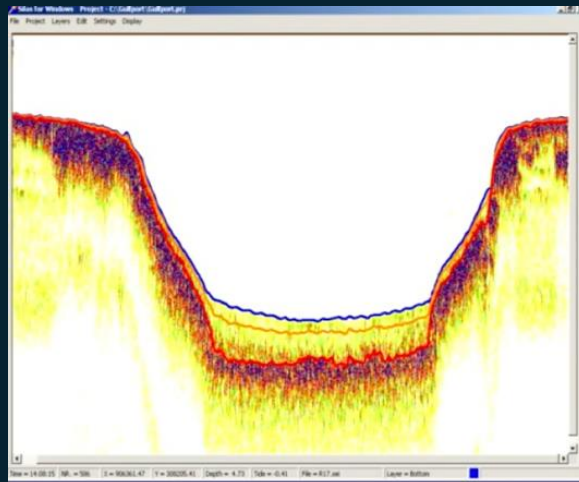


- ORIGINS
- HARDWARE
- PROOF OF CONCEPT
- **FIELD VERIFICATION**
- REFINEMENT
- TECHNOLOGY DISTRIBUTION

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More challenges

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DIGITAL RECORDING LINE 17  
LEGEND  
TOP SILT LAYER  
1.200kg/liter  
DENSITY LEVEL  
TOP CONSOLIDATED  
MATERIAL

**GULF PORT SHIP CHANNEL**  
DIGITAL RECORDING OF ODOM ECHOTRACK MK III  
24 kHz FREQUENCY

Lutocline – difference in sediment concentration

Navigable bottom – 1200g/l

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**WINGHEAD i87S**  
LMD-mode



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