Making use of SBP and Towed Magnetics Data

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Outline

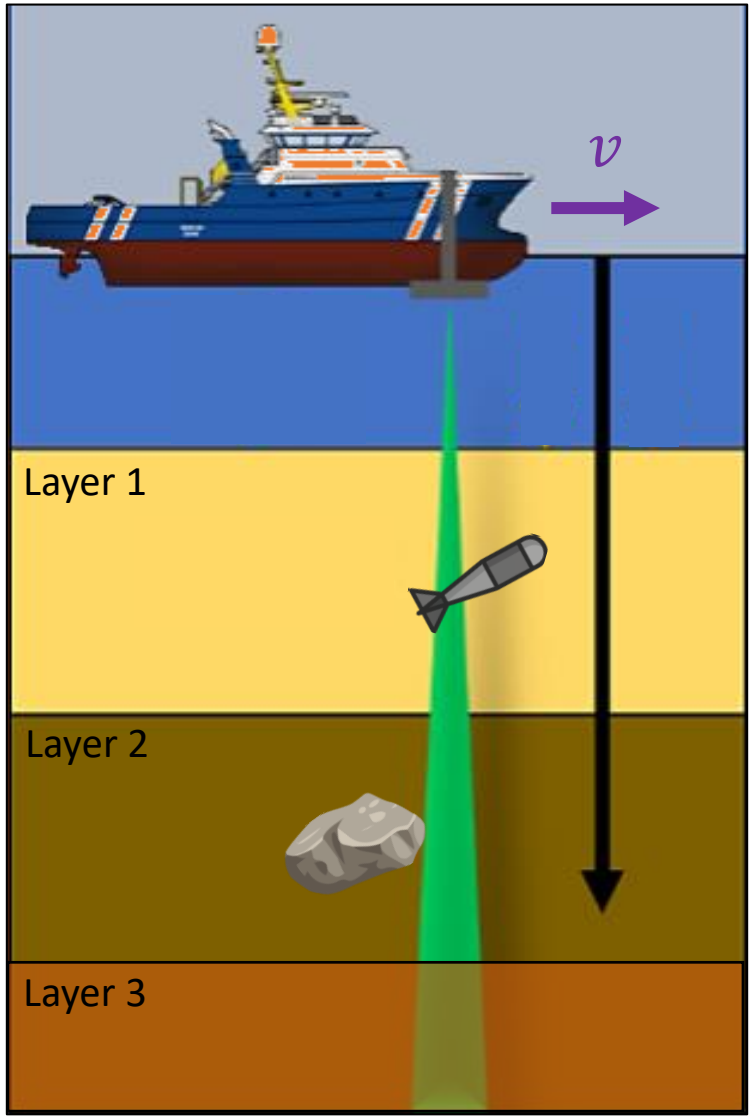
1. Testing **sub-bottom profiling (SBP)** for munition detection
   - Working principle
   - Data acquired
   - System modes
   - Detection ranges
   - Amplitude analysis

2. Testing **towed magnetics** for munition detection
   - Working principle
   - Data acquired
   - Mapping results
   - Sensitivity
   - Comparison with SBP

3. Multi-sensor **integration**

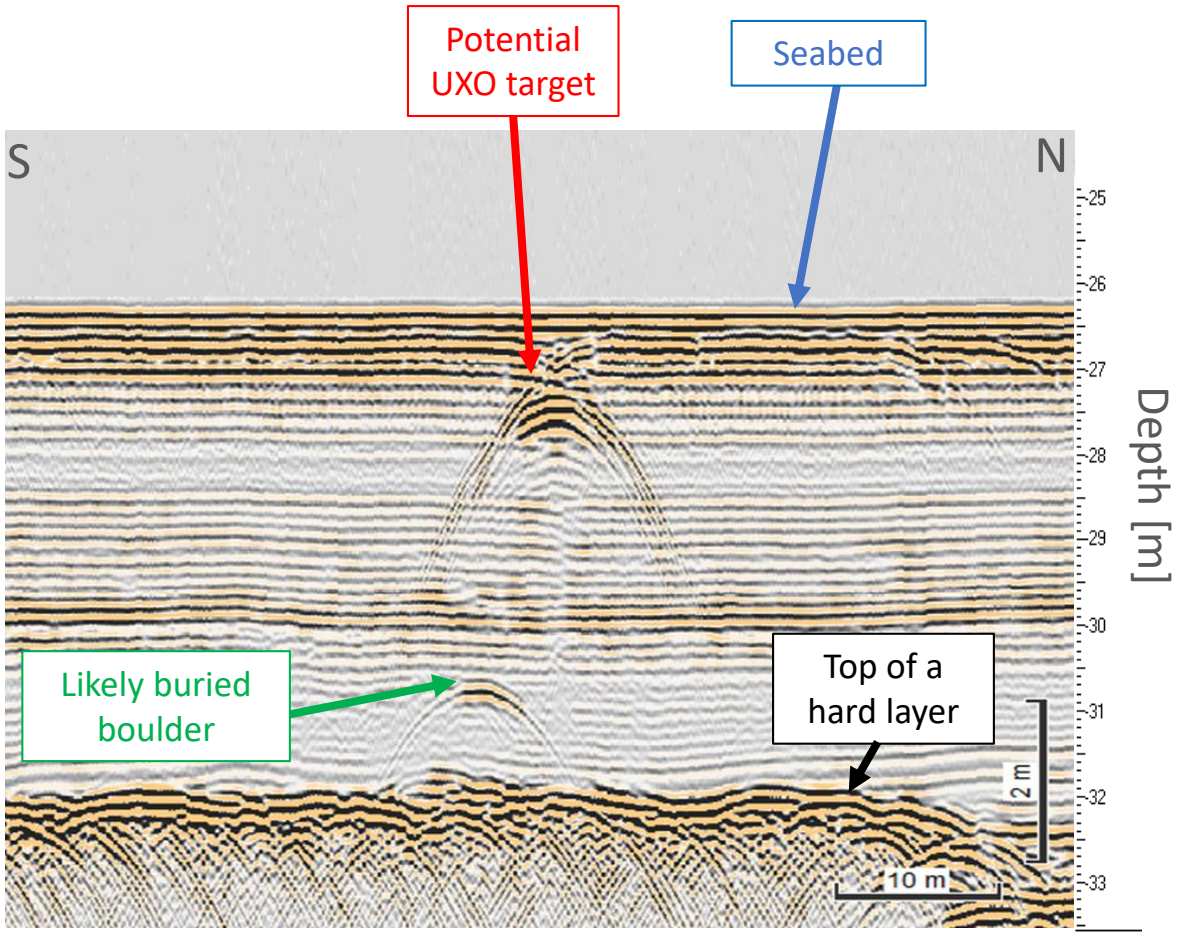
4. Setting up an **artificial intelligence (AI) workflow** for SBP data

Sub-Bottom Profiler (SBP)



Acoustic signal

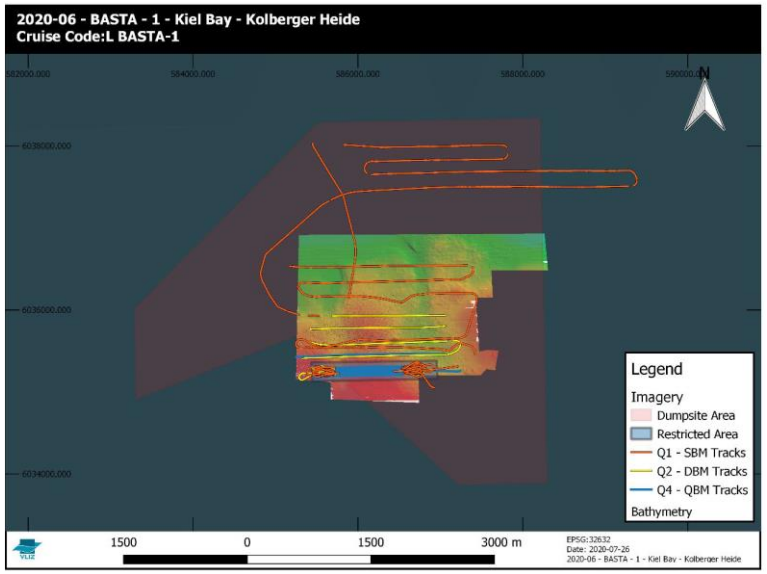
Acoustic Profile



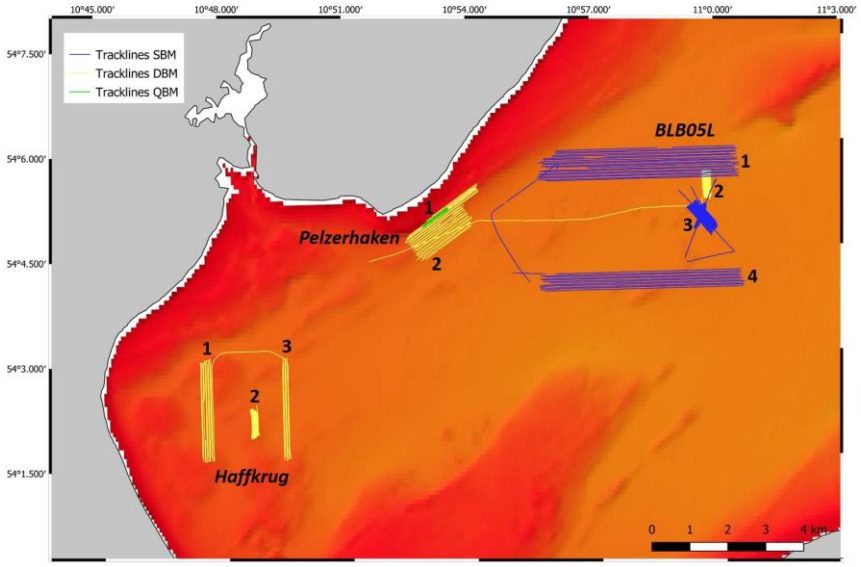
Overview

~270 km

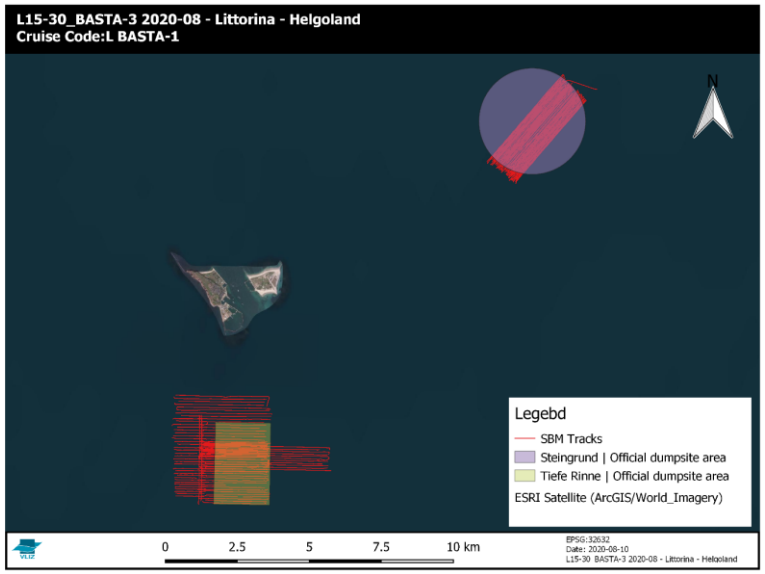
3 Surveys



June 2020: Kolberger Heide



July 2020: Lubeck Bay

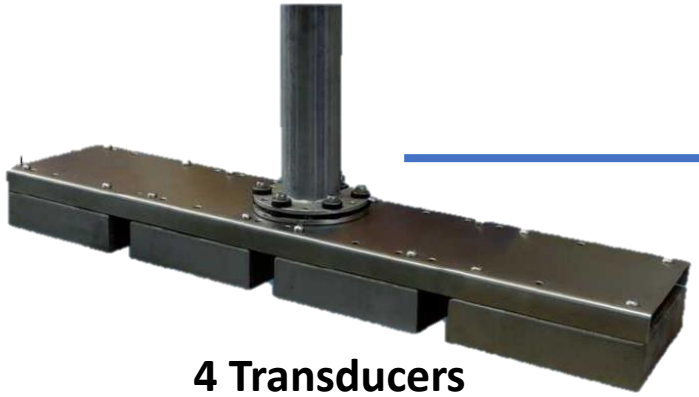


August 2020: Helgoland

Innomar SES-2000 quattro

- Components:

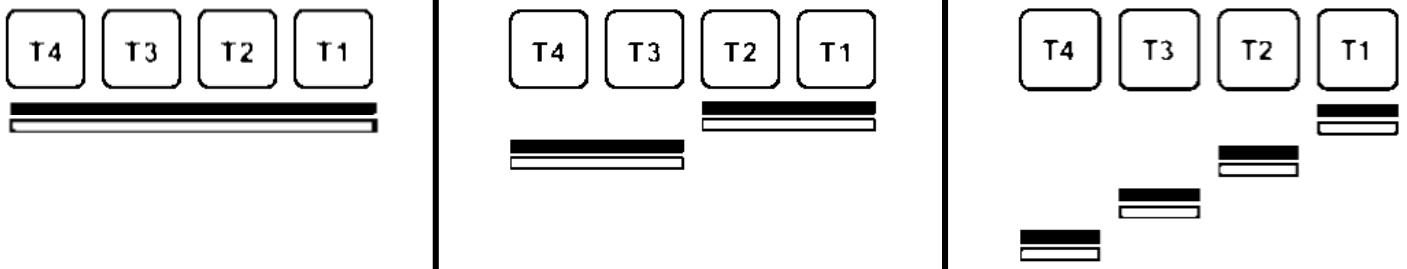
Acquisition unit



4 Transducers

+ Motion sensor
+ GPS

- **Multi-transducer** SBP:

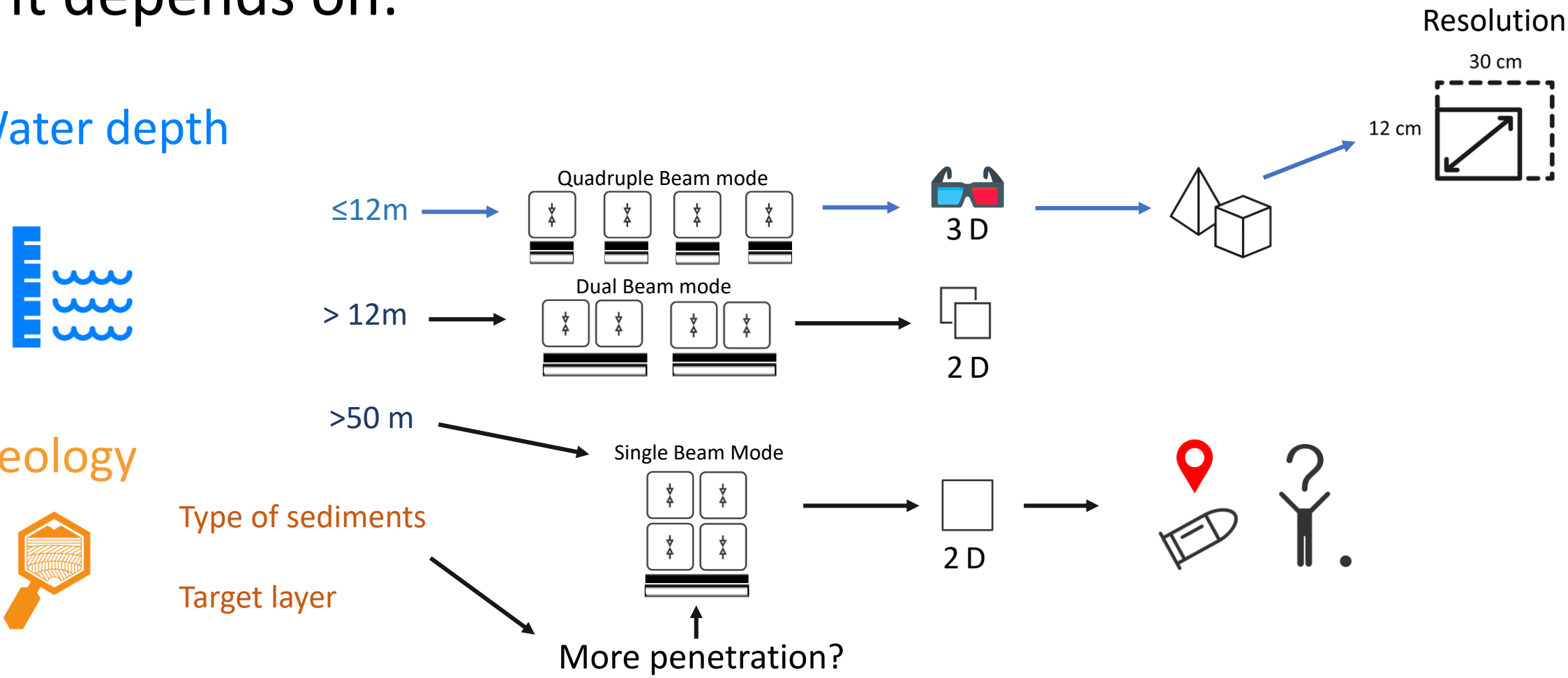


Single Beam Mode | Dual Beam Mode | Quadruple Beam Mode

Kolberger Heide, RV Littorina (June 2020)

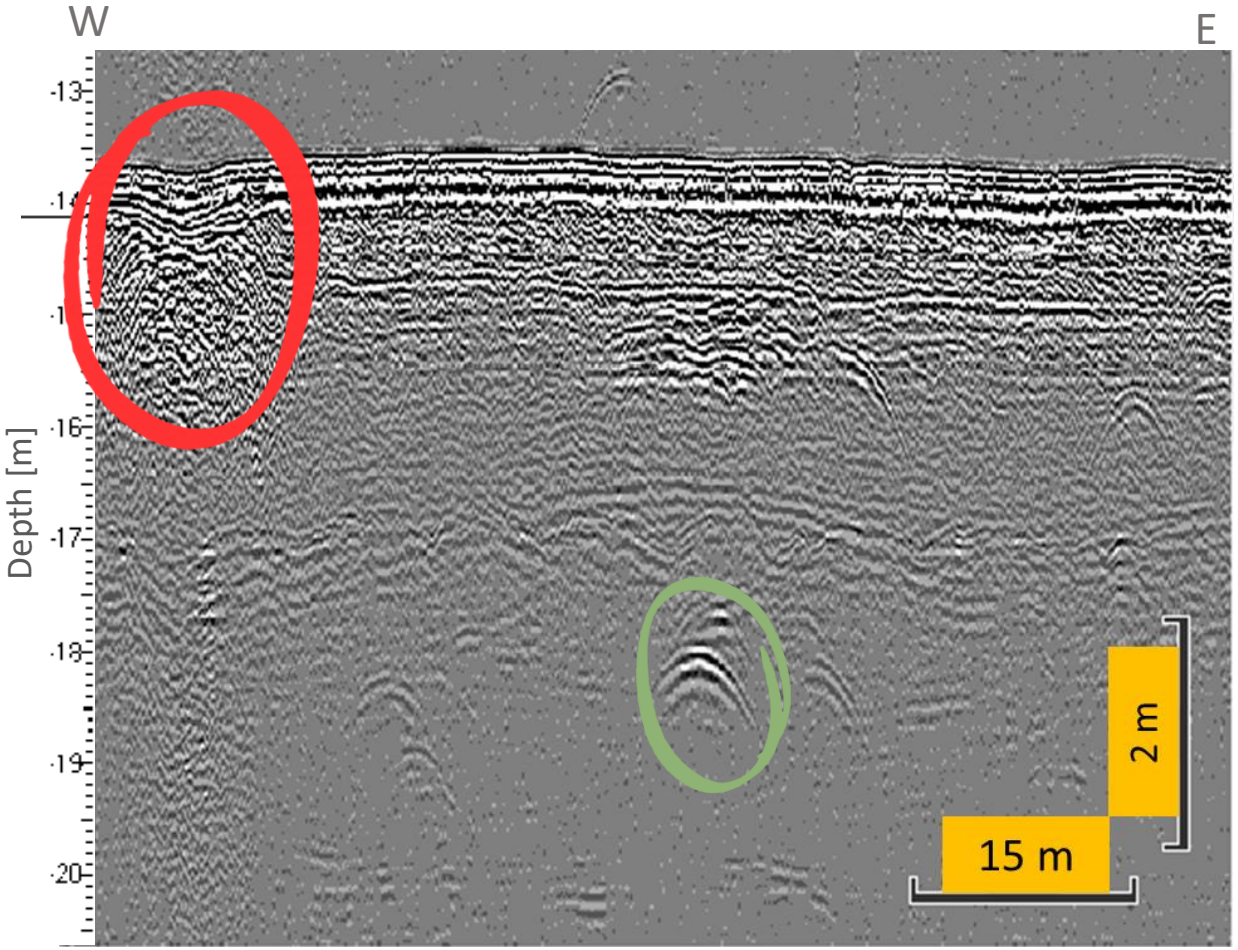
Which mode is the best?

→ it depends on:

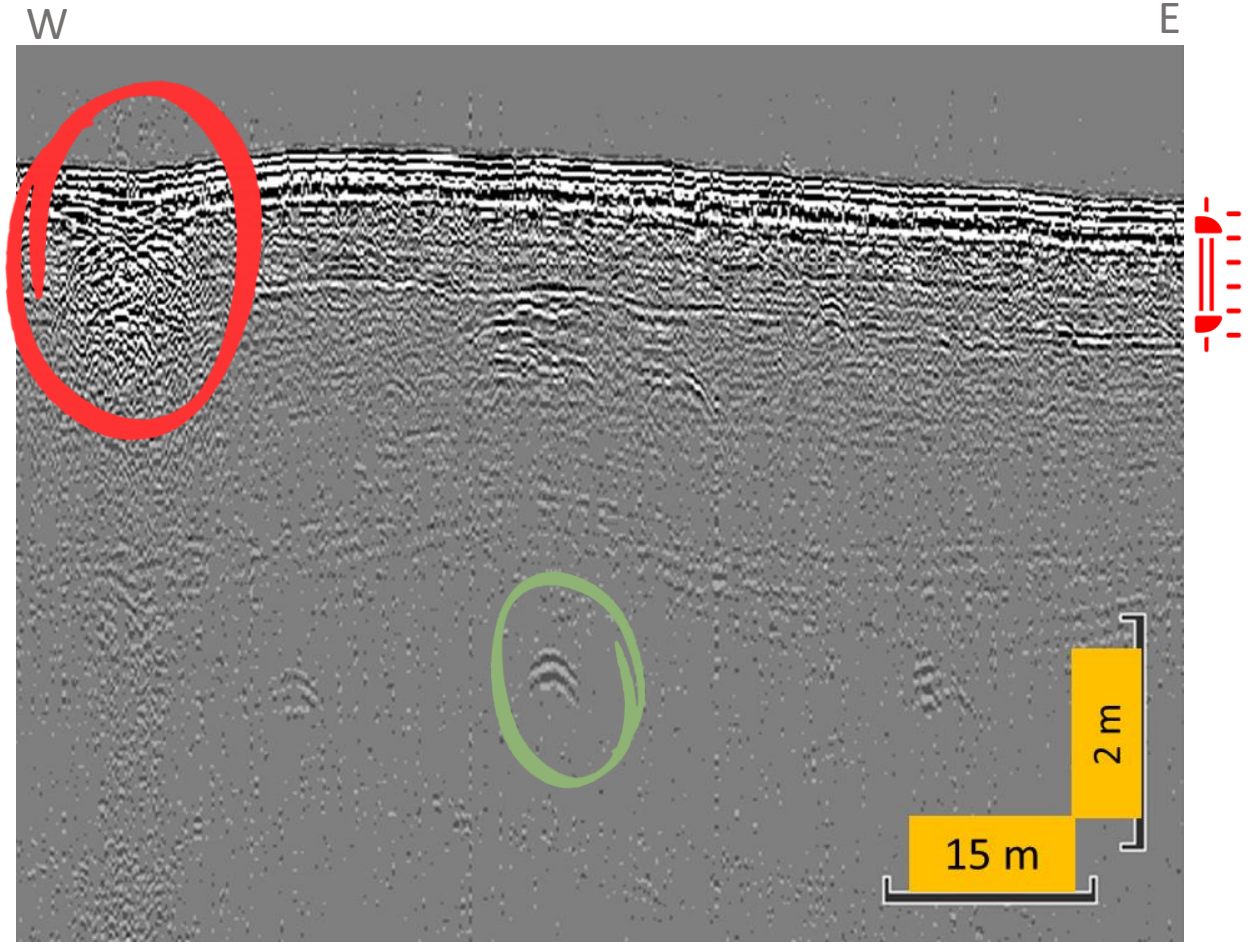


Which mode is the best?

Dual Beam Mode

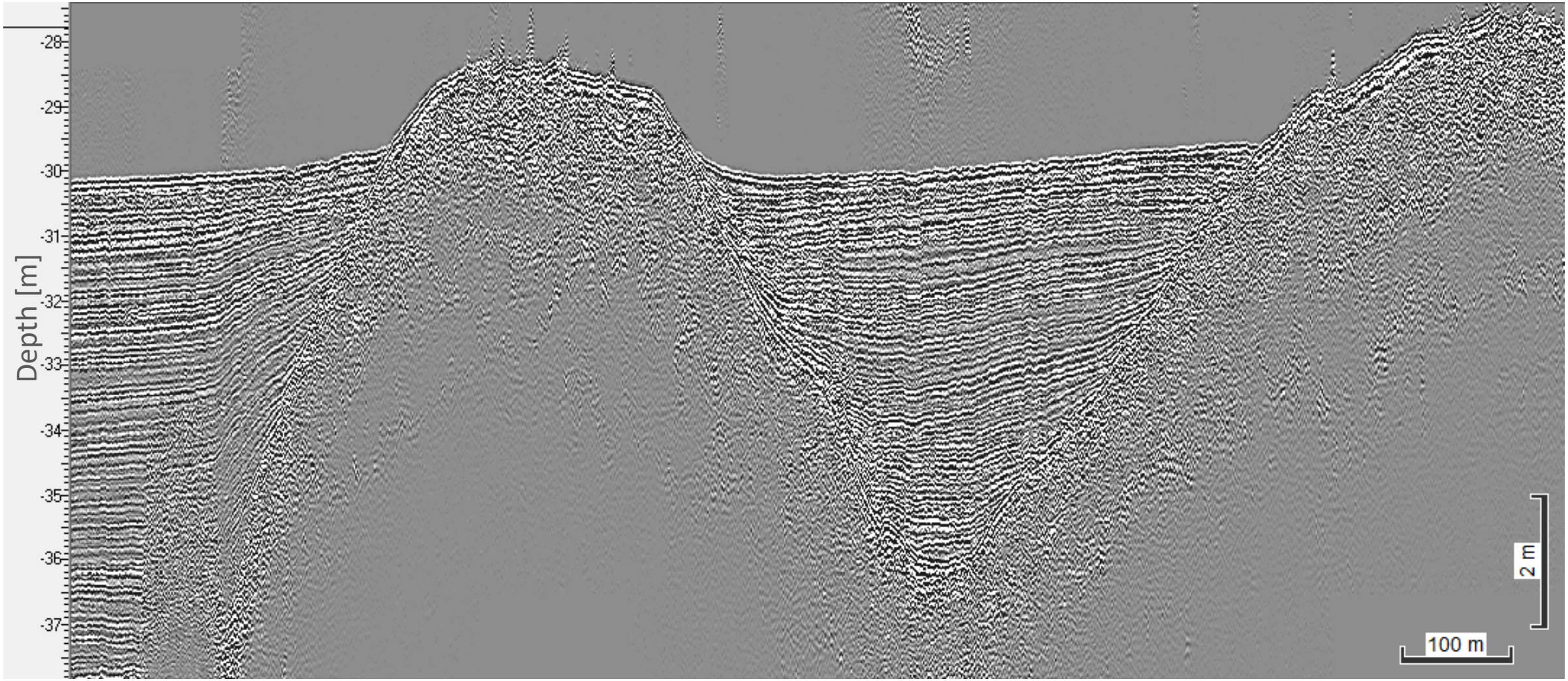


Quadruple Beam Mode

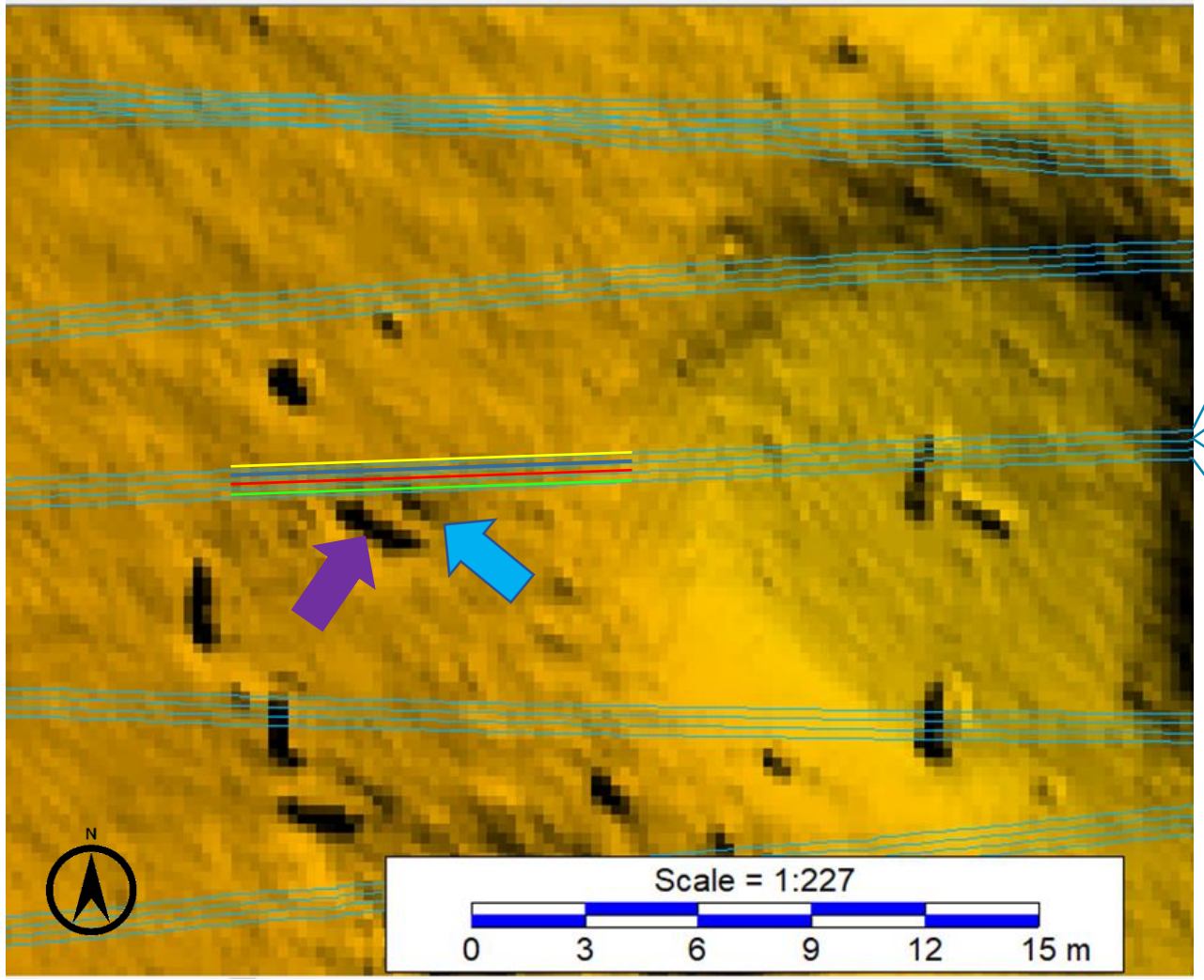


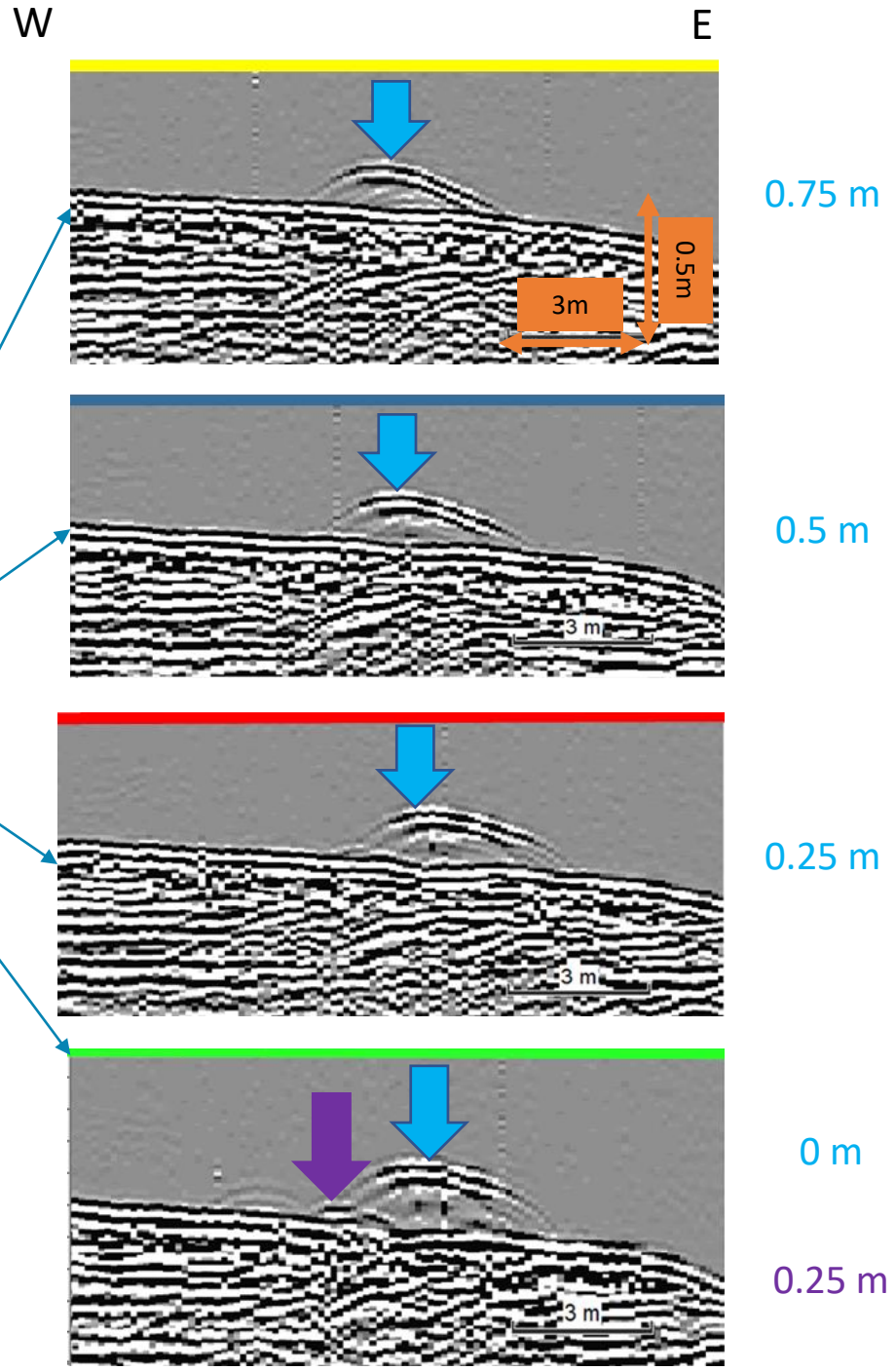
Which mode is the best?

Single Beam Mode



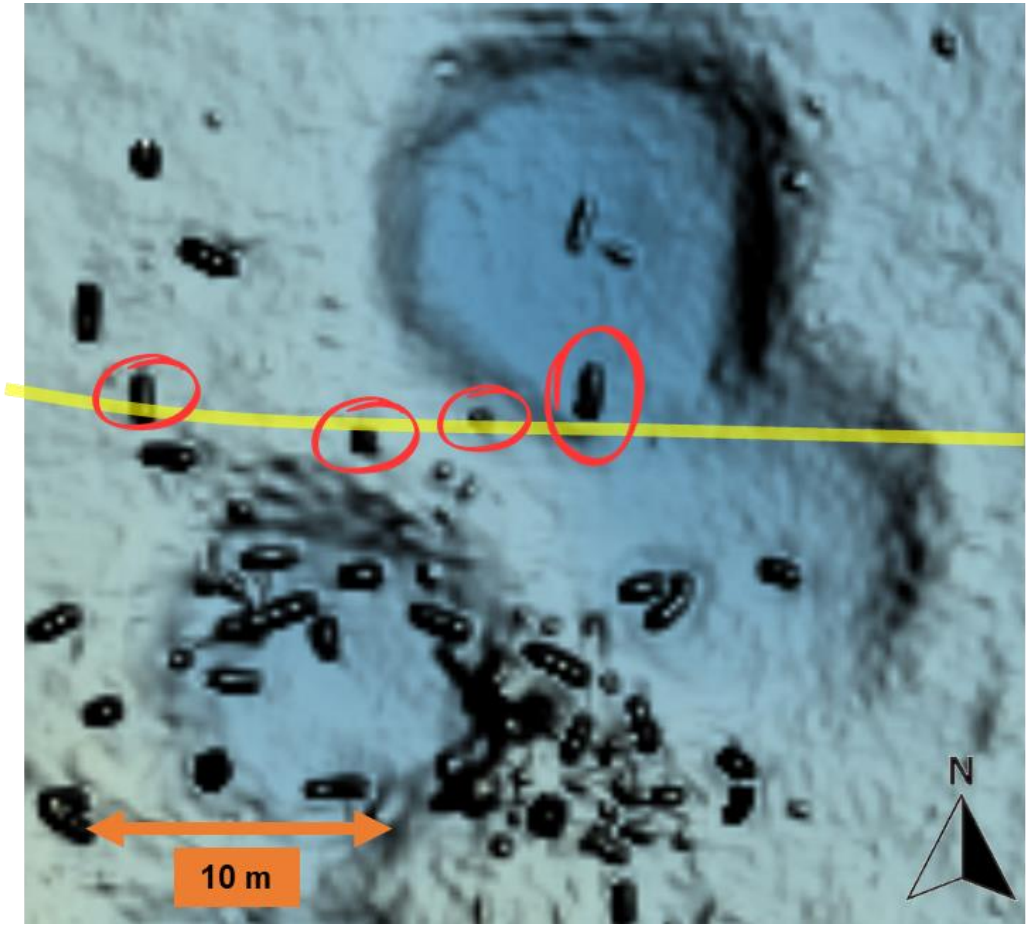
Detection ranges



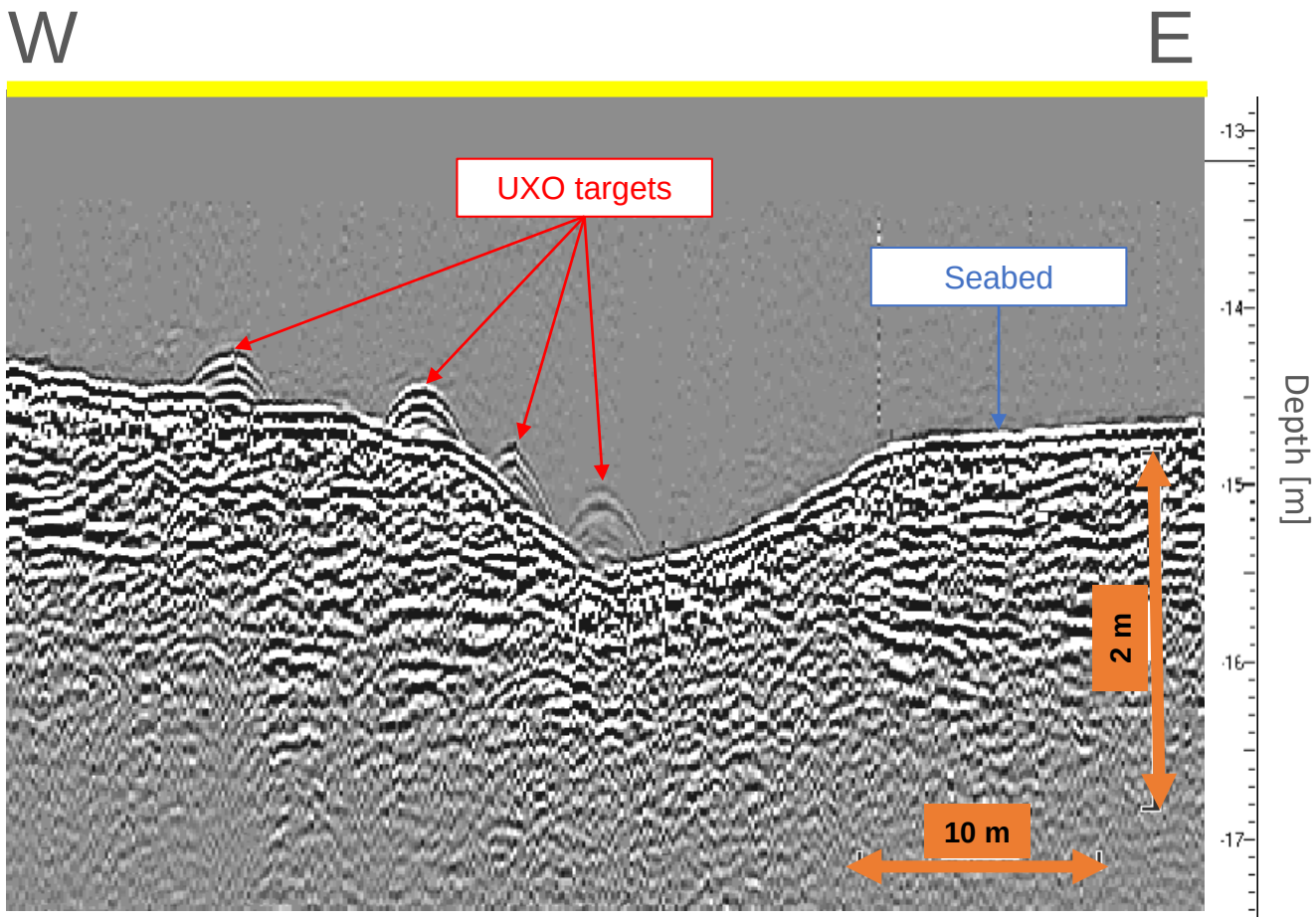


Detection ranges

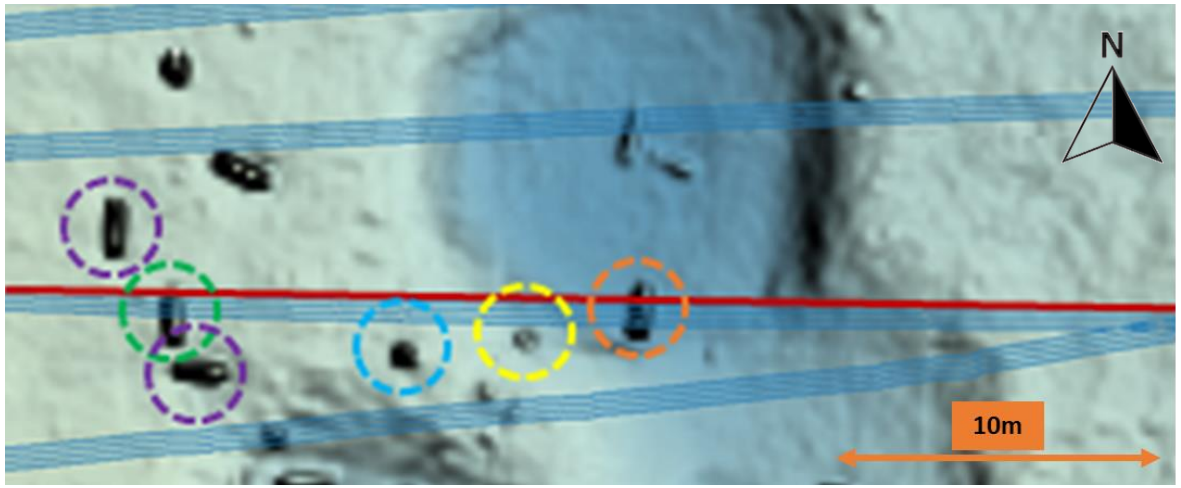
MBES+SBP track

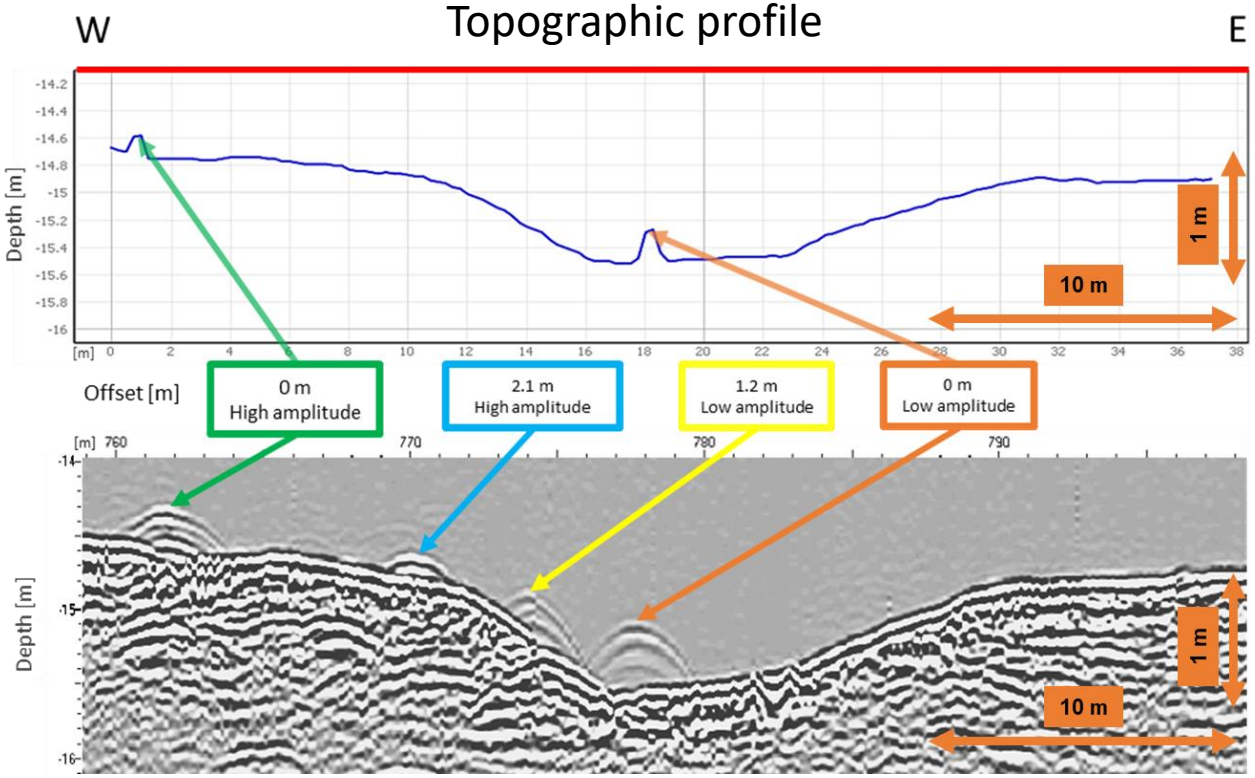


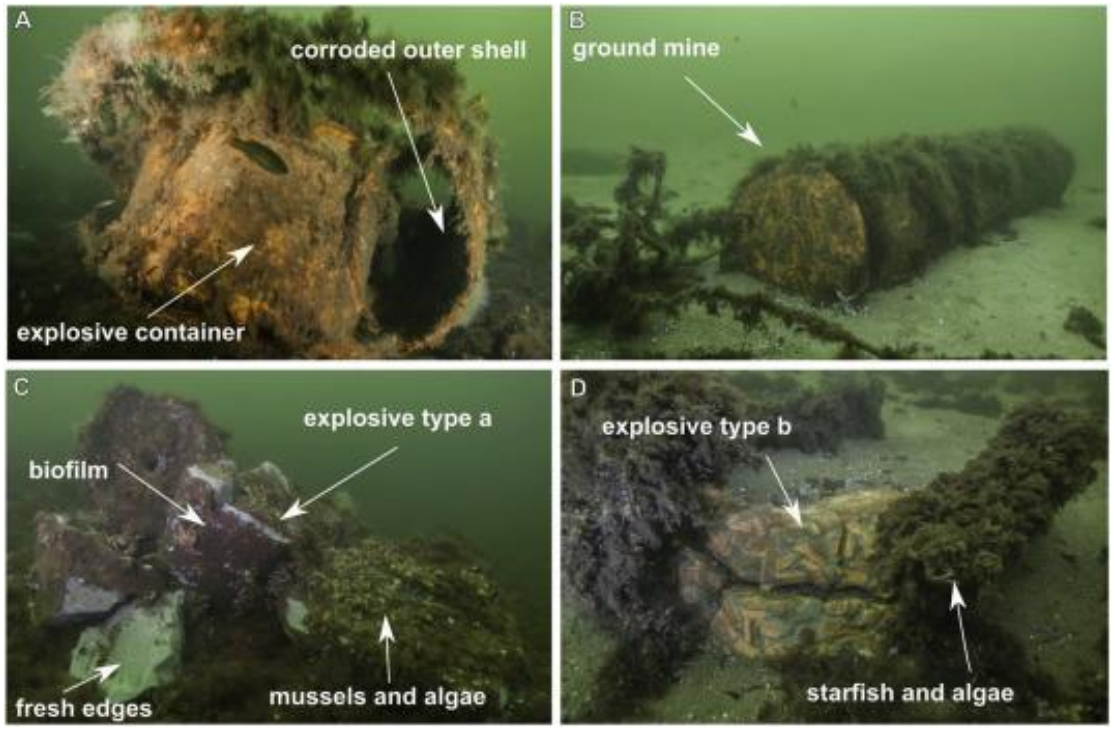
SBP profile



Amplitude analysis

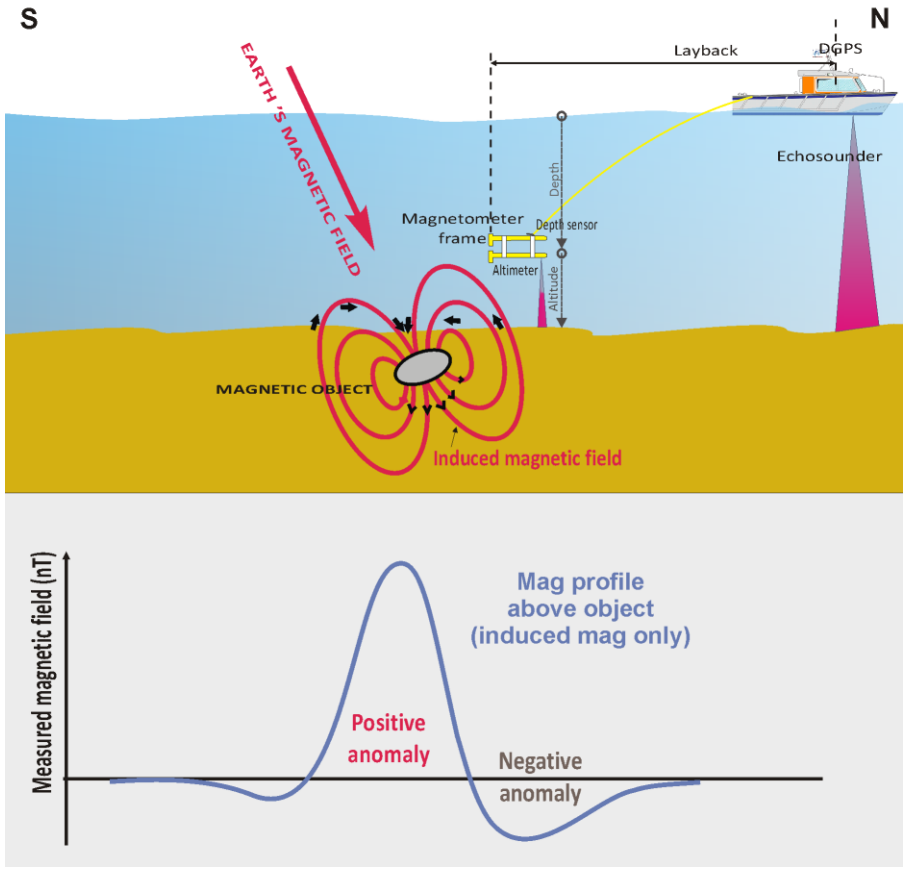


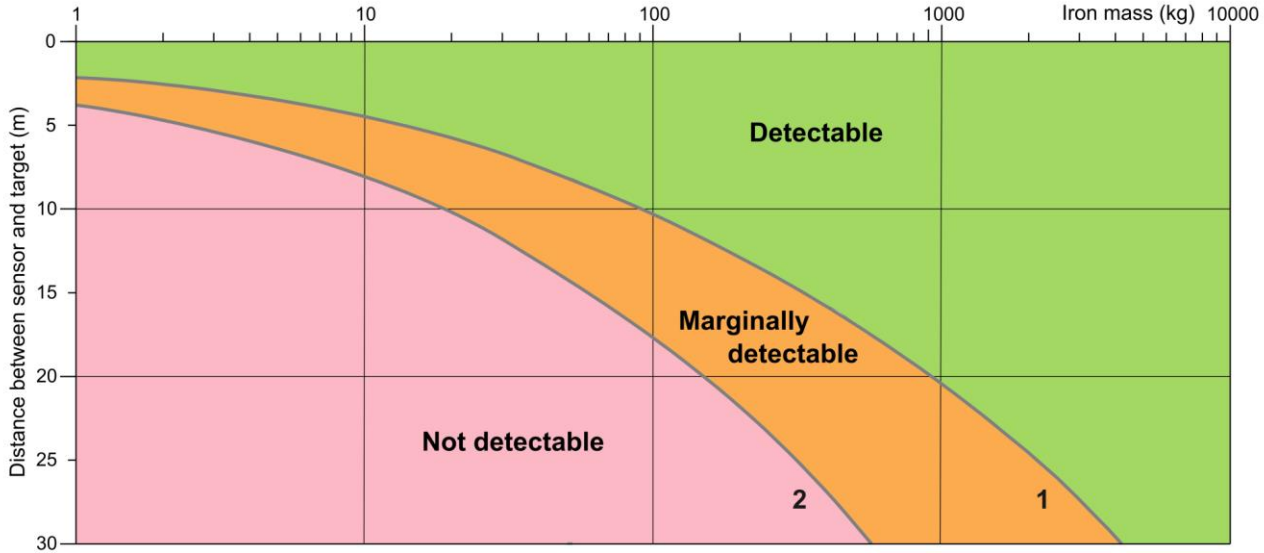




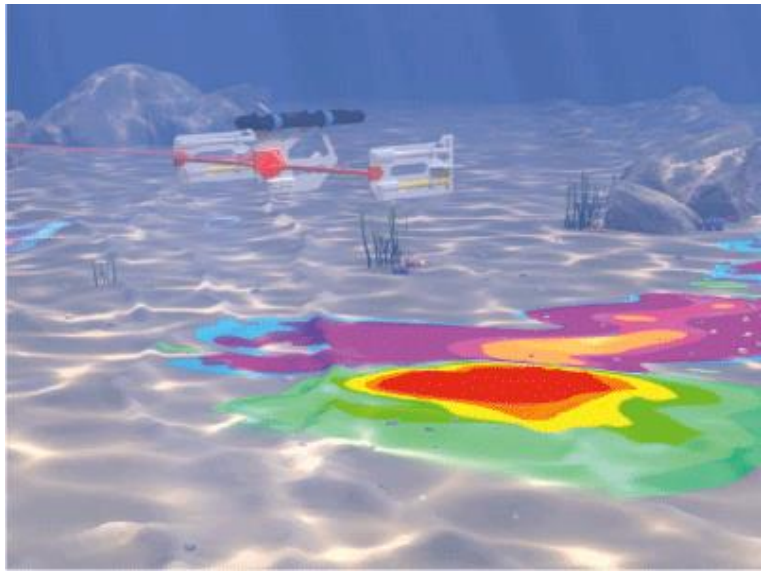
Underwater photos taken by Jana Ulrich

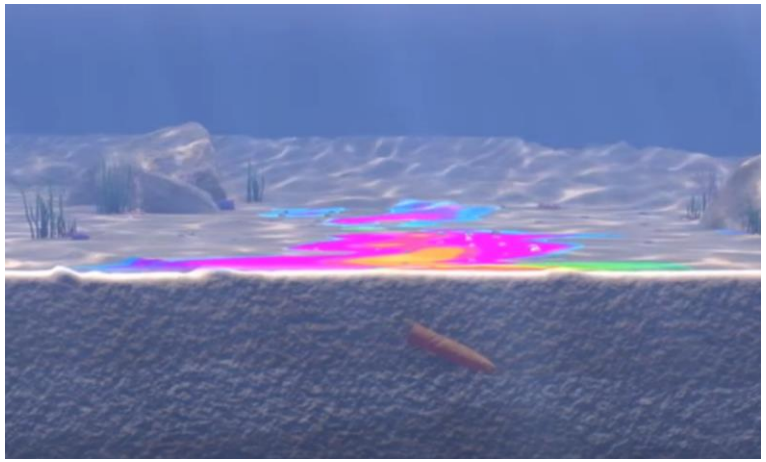
Magnetometry/Gradiometry





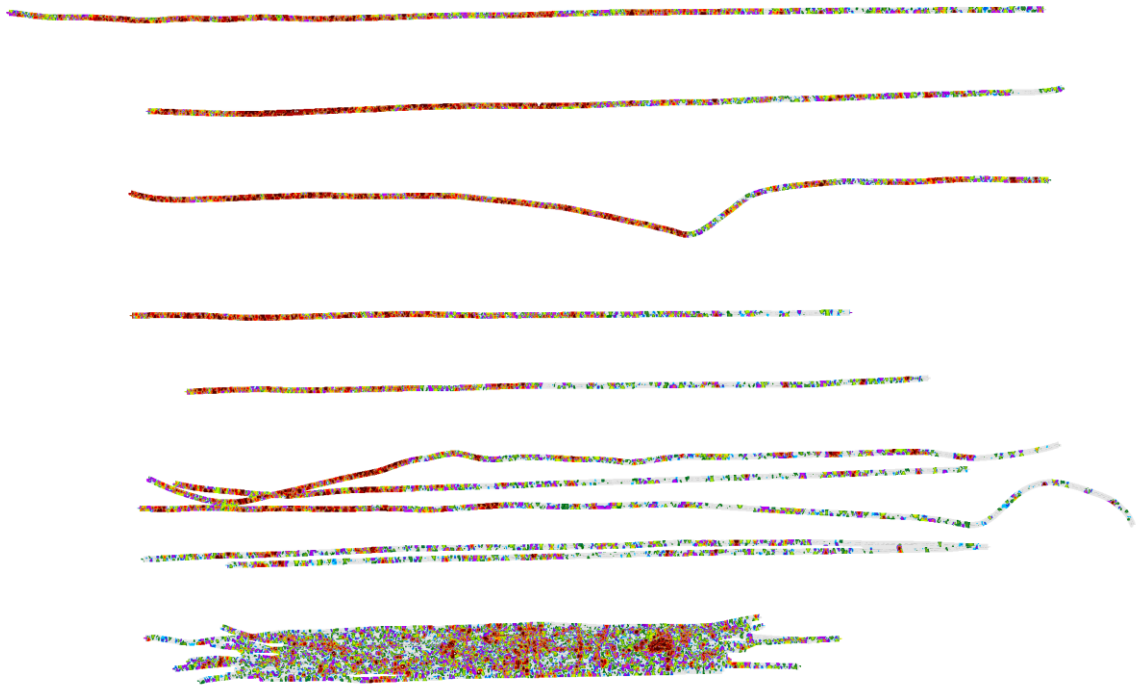
Magnetics: MagWing®



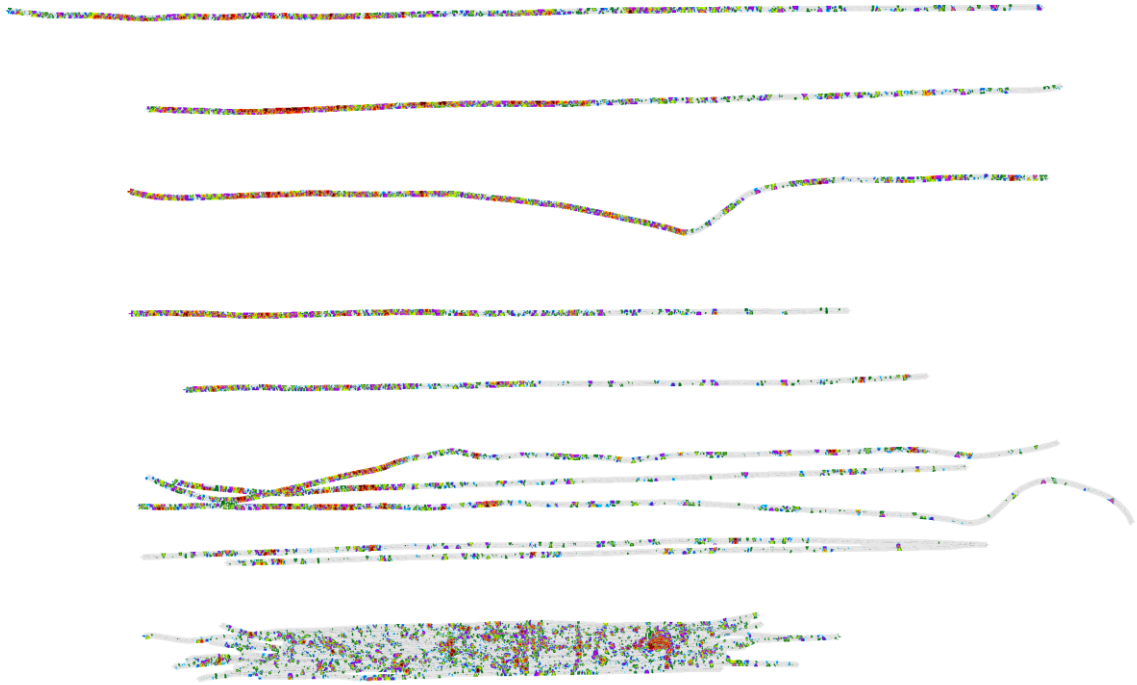


Kolberger Heide Survey Results

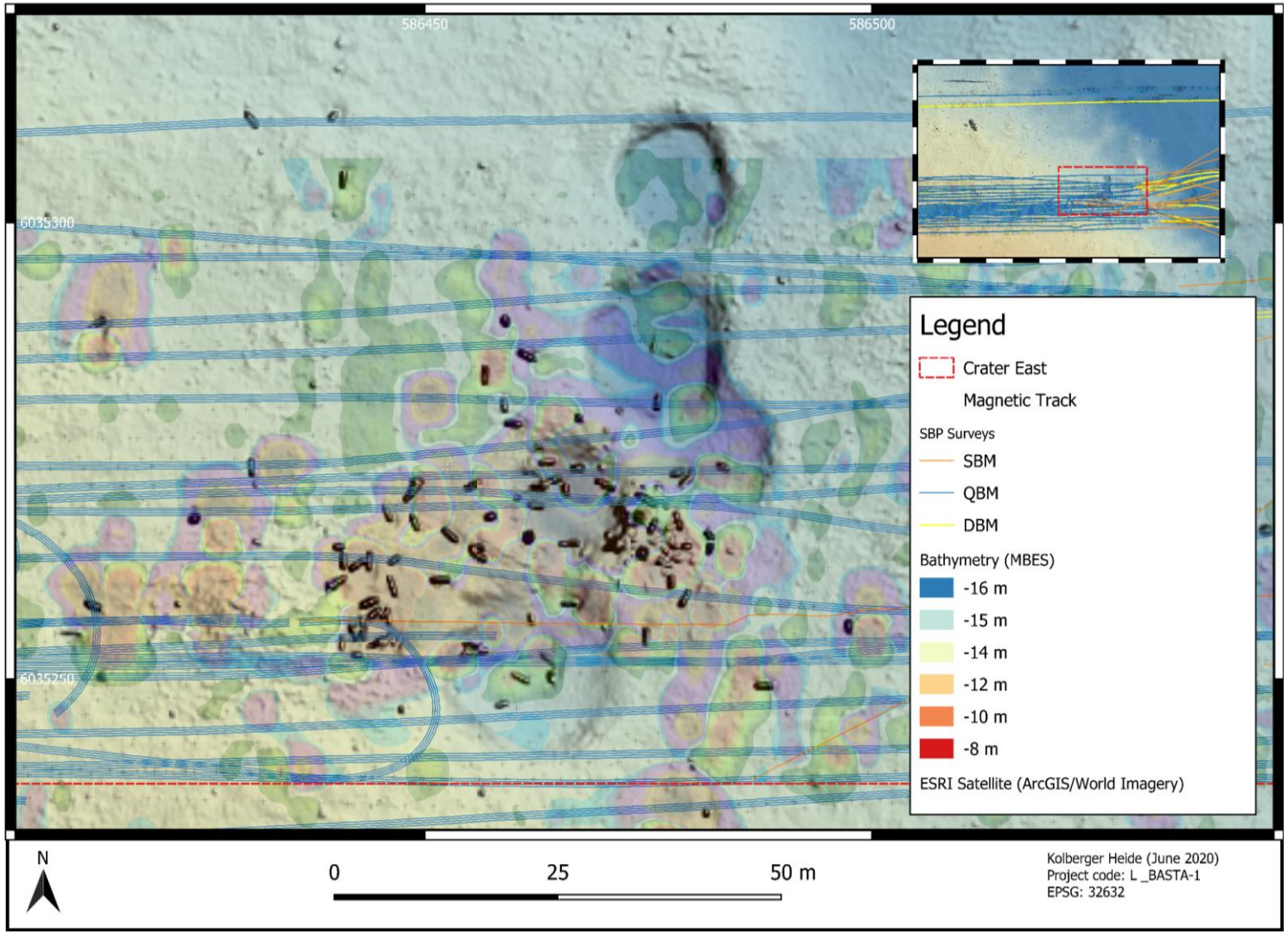
Vertical magnetic gradient
Colour scale -500 to + 500 nT/m



Vertical magnetic gradient
Colour scale -2000 to + 2000 nT/m



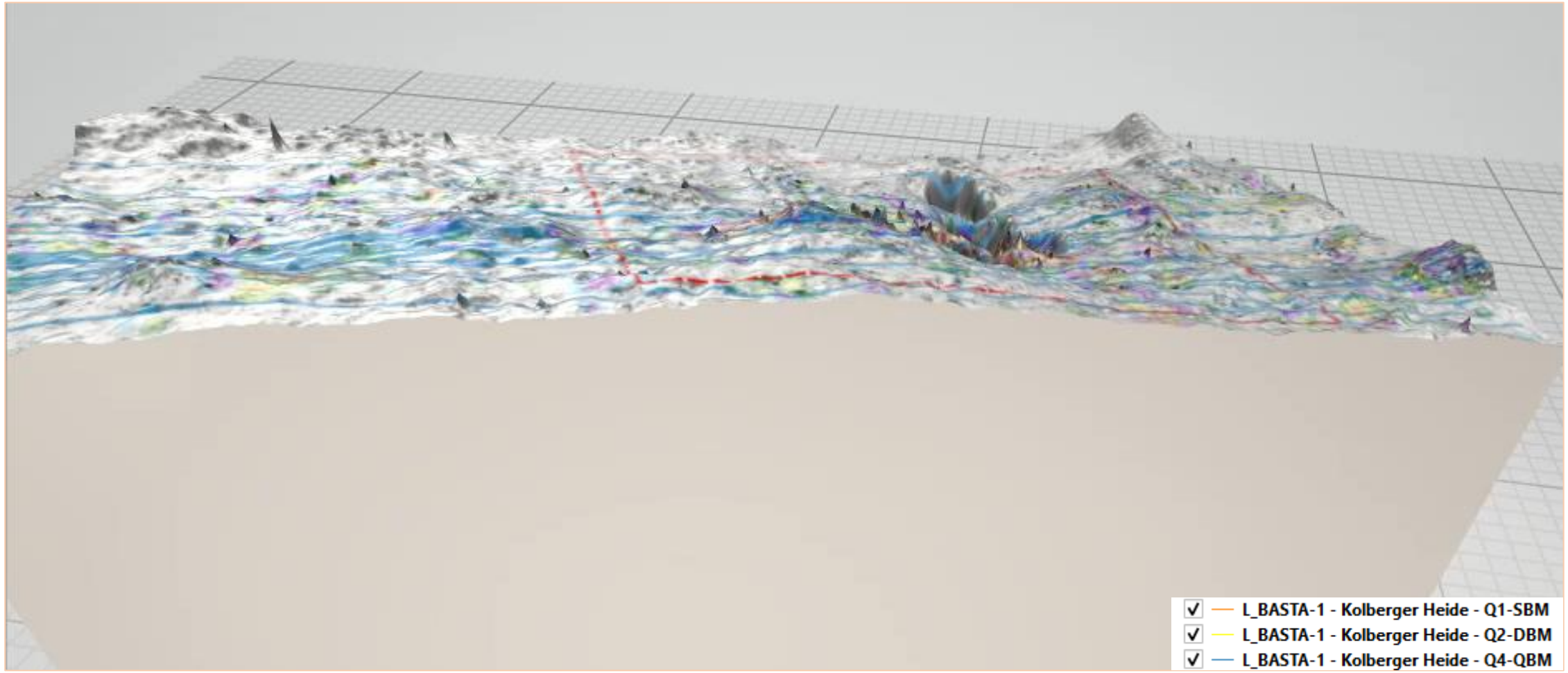
Multi-sensor Integration



MBES + Magnetics + SBP

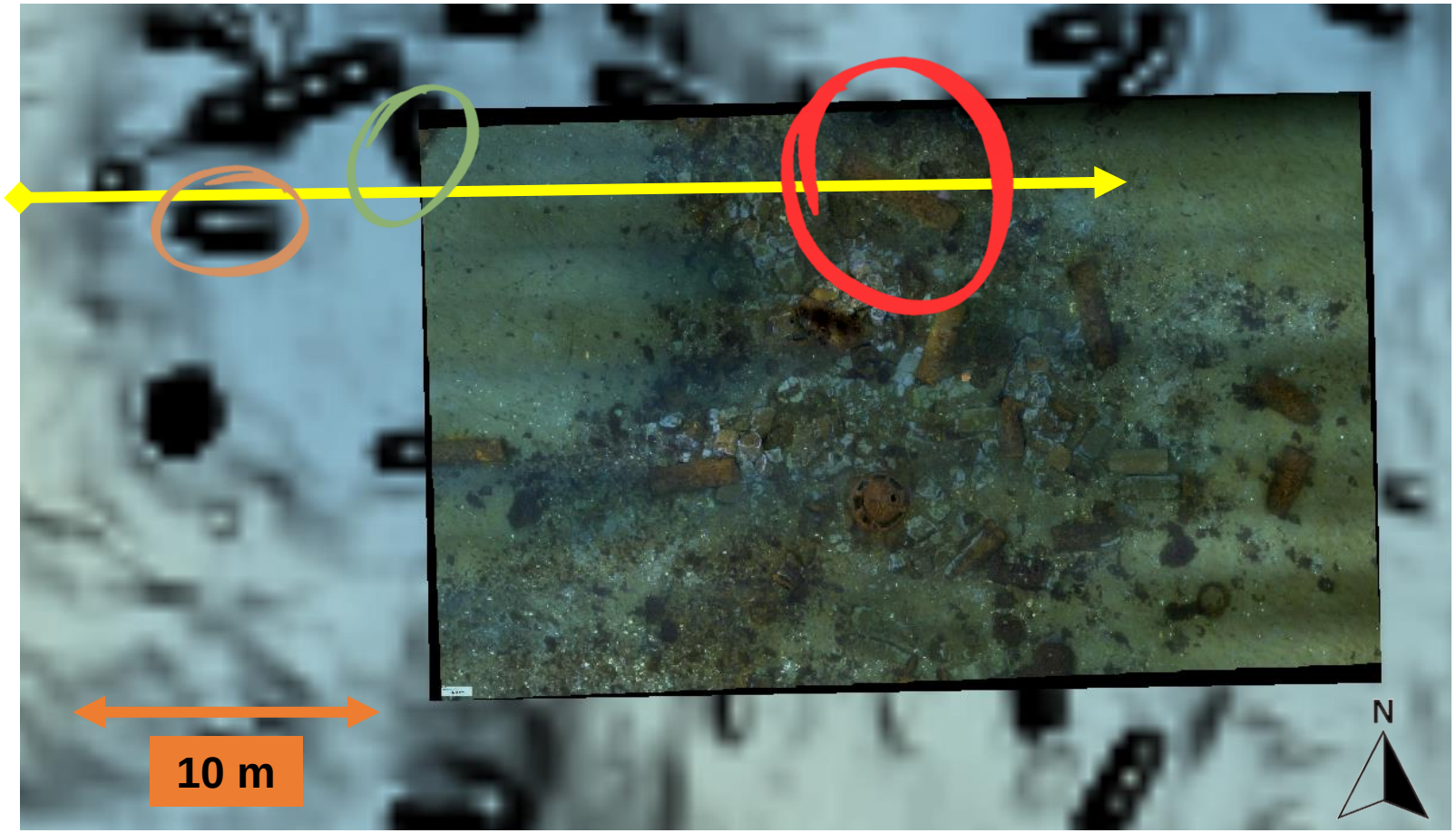
Multi-sensor Integration

SBP tracks
MBES
Magnetic data

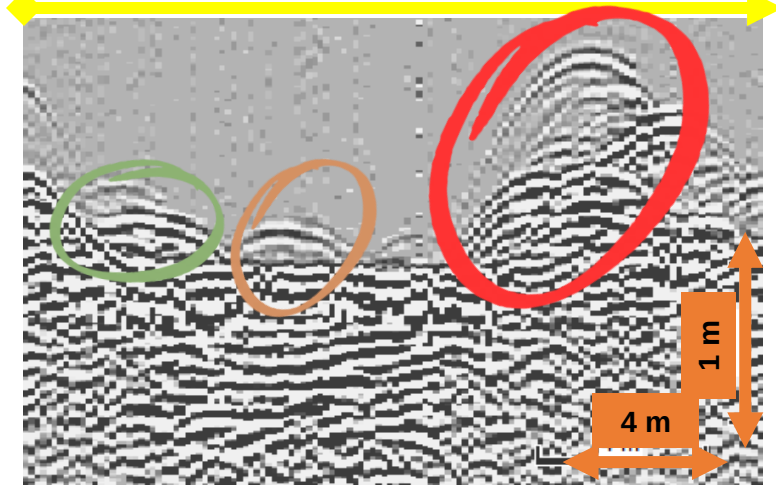


Multi-sensor Integration

MBES + Photomosaic

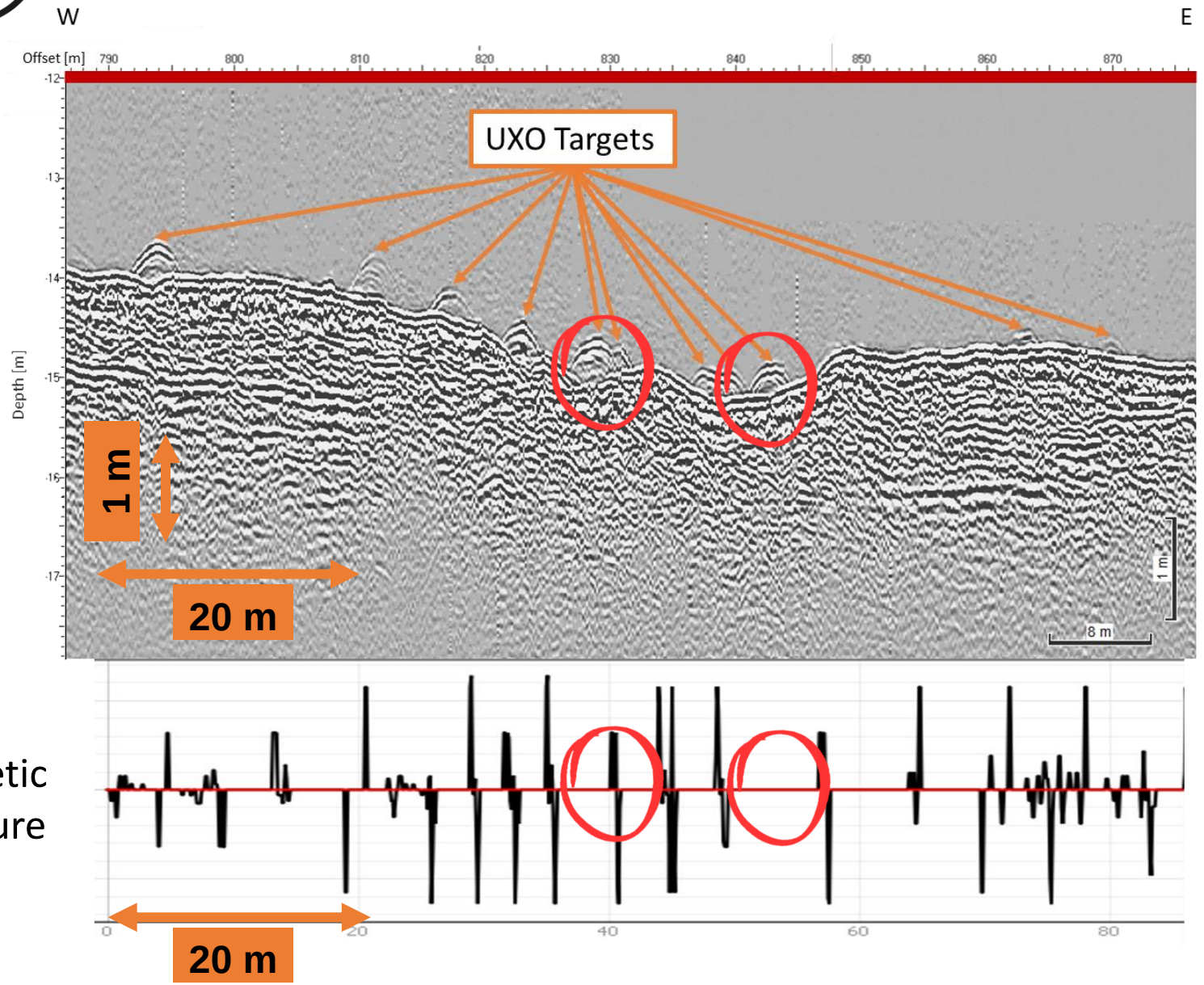


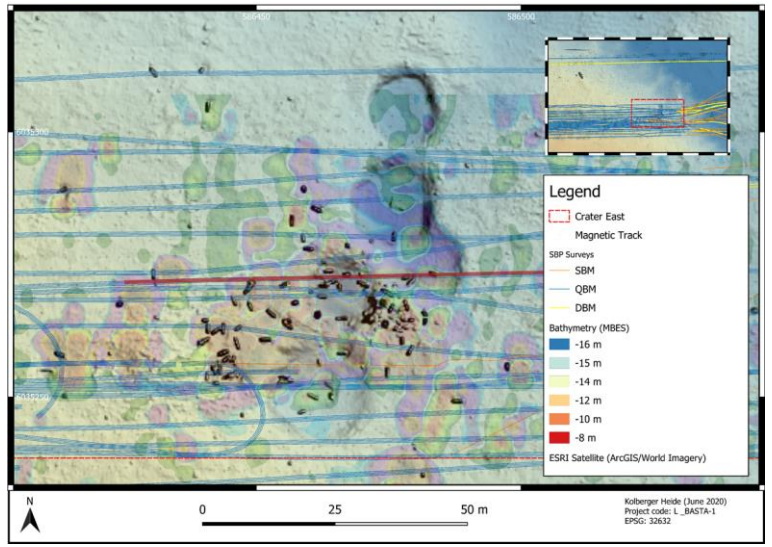
SBP Profile



Multi-sensor Integration

SBP

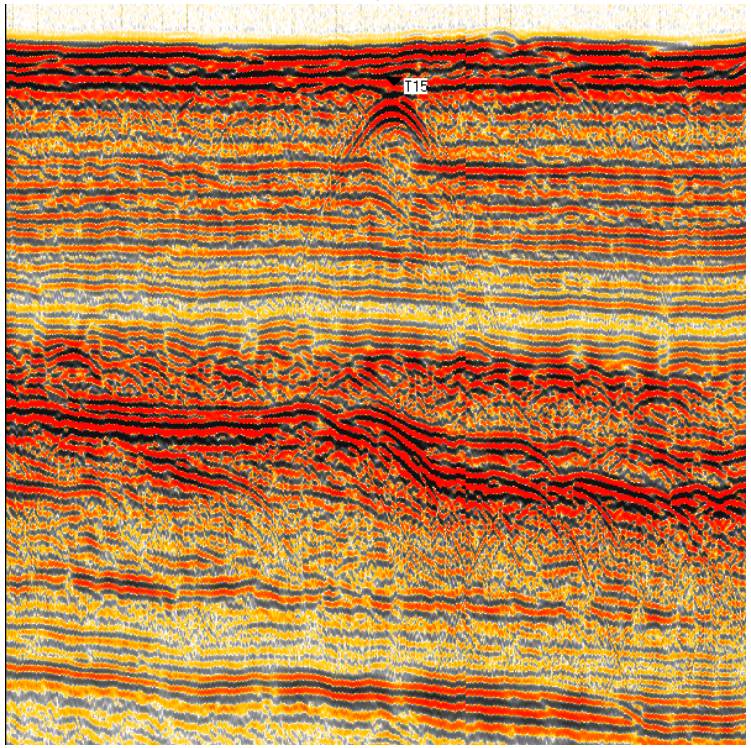


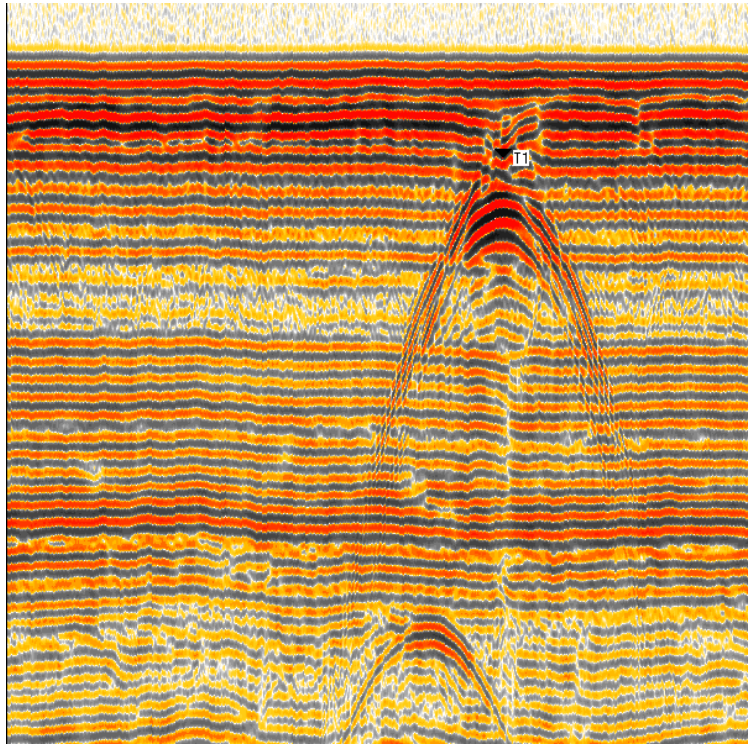


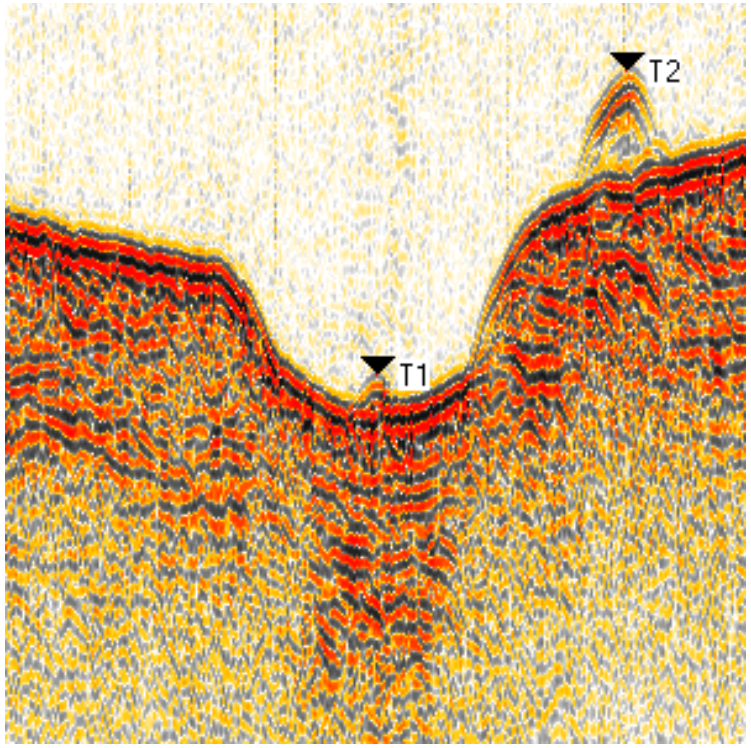
MBES + Magnetics + SBP tracks

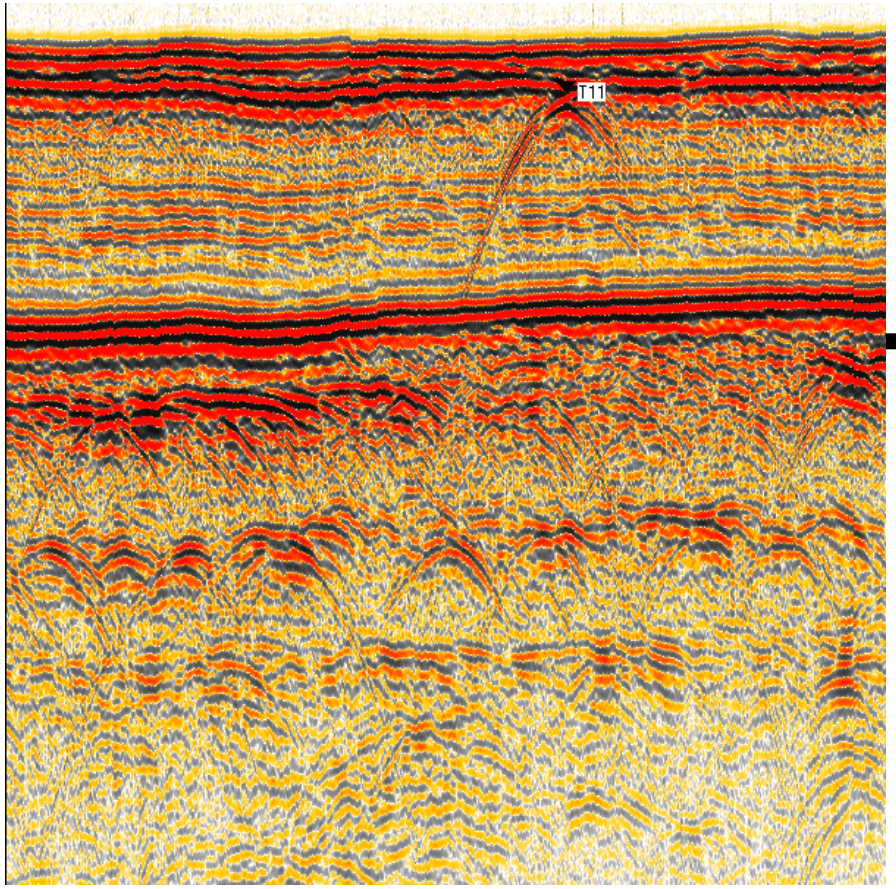
Initial steps in automated target picking

AI

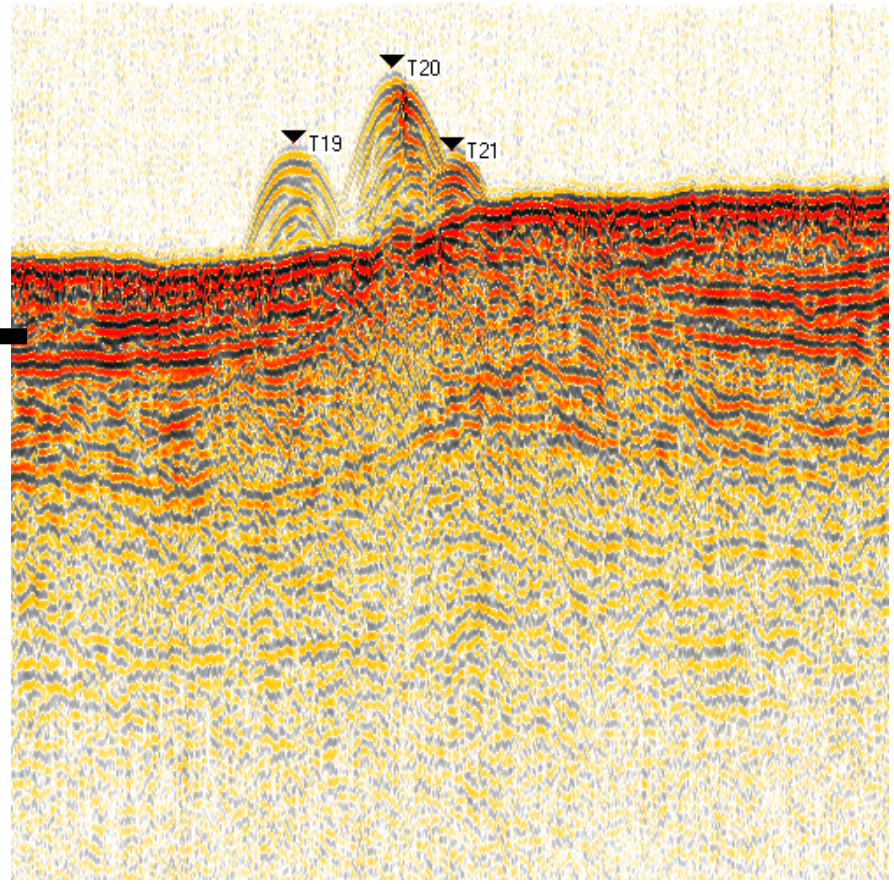




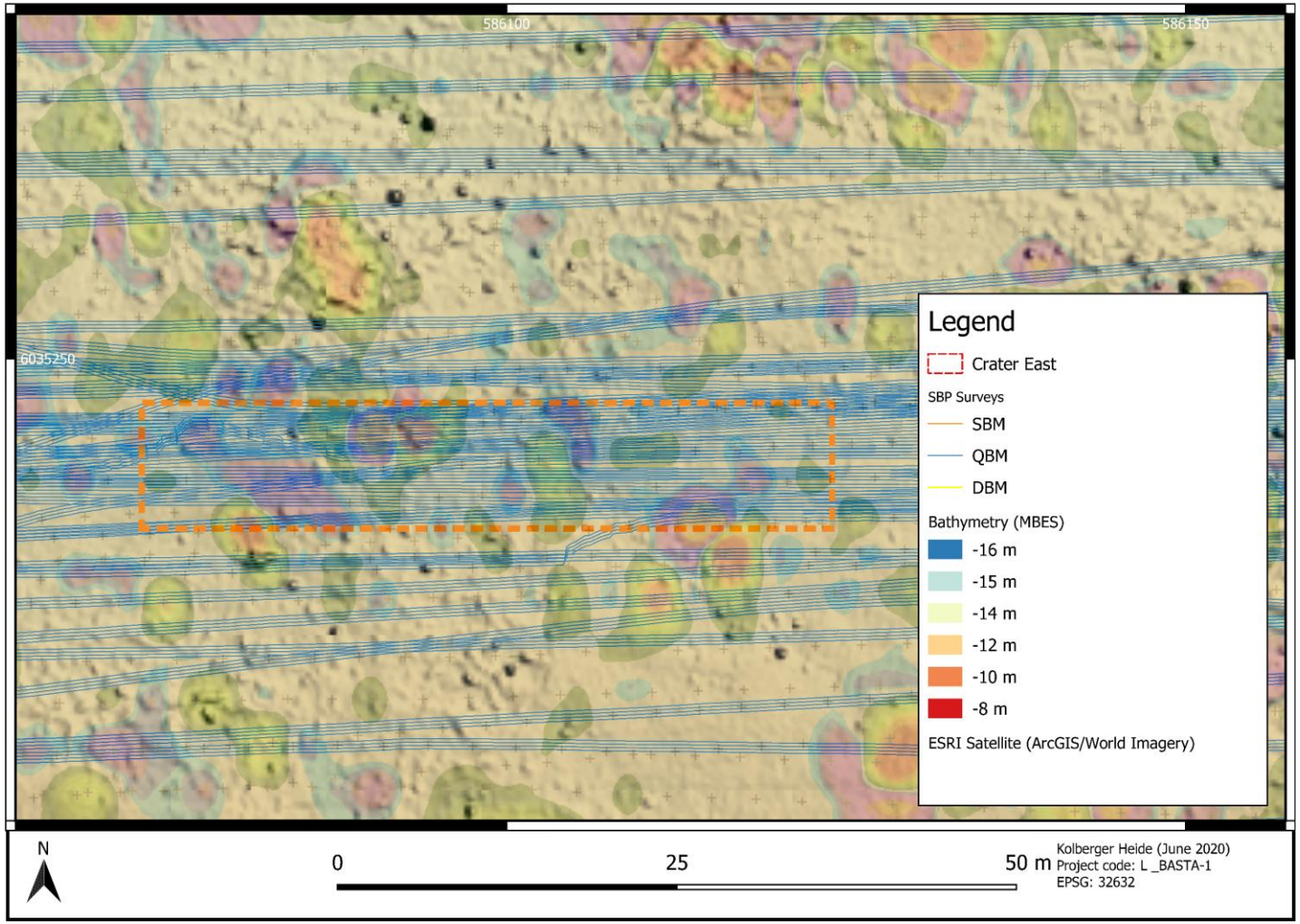




Pxl. XYZ

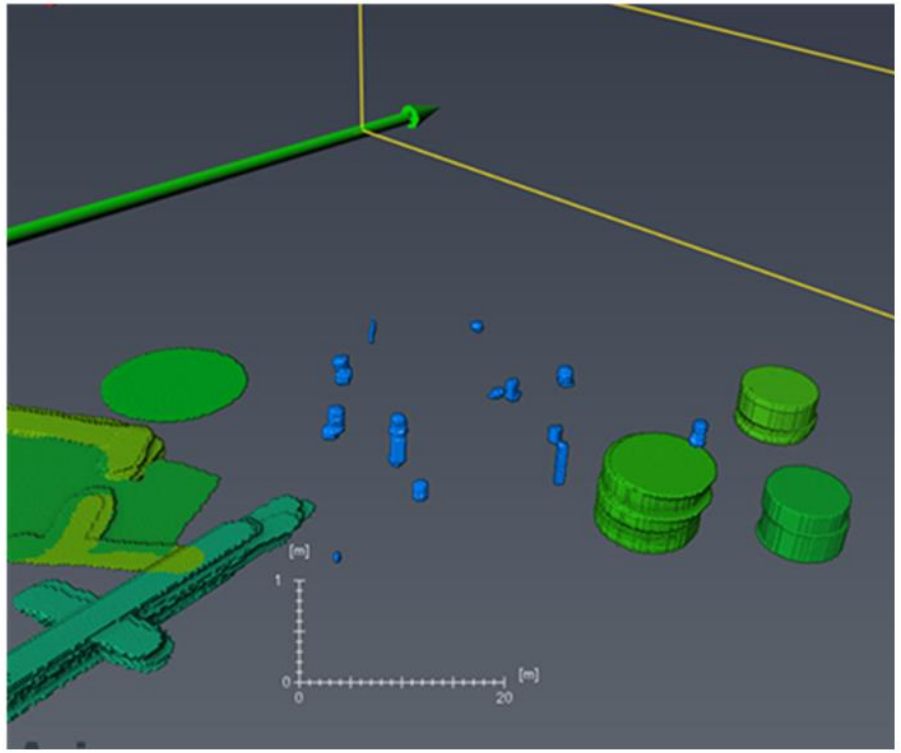


Outlook



30 cm

12 cm



3D example: Archaeological site at the Belgian coast reprocessed and modeled

Conclusions

Lessons learned

- The expression of munition at and below the seafloor in SBP data (influence of system mode, governing factors)
- The limitations of SBP, and how they can be overcome by integrating other methods (MBES, magnetics)

Ongoing work

- Developing an AI feeding workflow for automated munition detection in SBP data

Future work

- From 2D sub-bottom profiles to 3D volumes and areas with buried targets.

VLIZ

BASTA

G-tec