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Multi-transducer sediment echo sounder for 3D documentation of submerged archaeological sites - a case study at a prehistoric pile dwelling at Lake Mondsee (Austria)



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**Multi-transducer sediment echo sounder
for 3D documentation of submerged archaeological sites
- a case study at
a prehistoric pile dwelling at Lake Mondsee (Austria)**

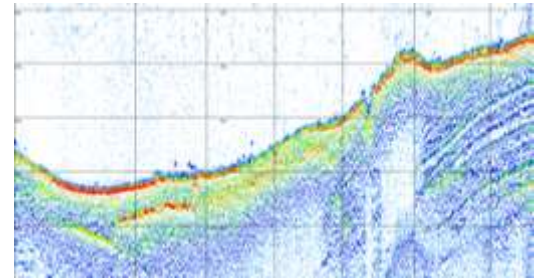


Introduction

Detection and mapping of submerged and the buried archaeological remains

Parametric Sub Bottom Profiler (SBP)

- well established in archaeological prospection
- 2D

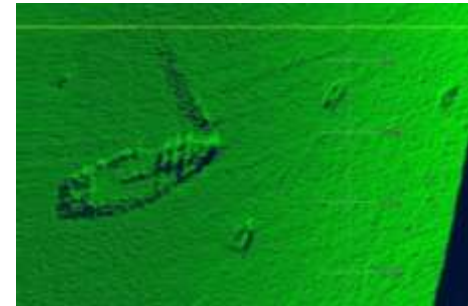


Multi-transducer Parametric Sub-Bottom Profiler

➔ 3D investigation

High end Multi beam echosounder

- Kongsberg, Reson, R2Sonic



Case study:

- prehistoric pile dwelling at Lake Mondsee



prehistoric pile dwelling “See” at Lake Mondsee (Austria)

Reconstruction of site „Kammern“ (Lake Attersee)

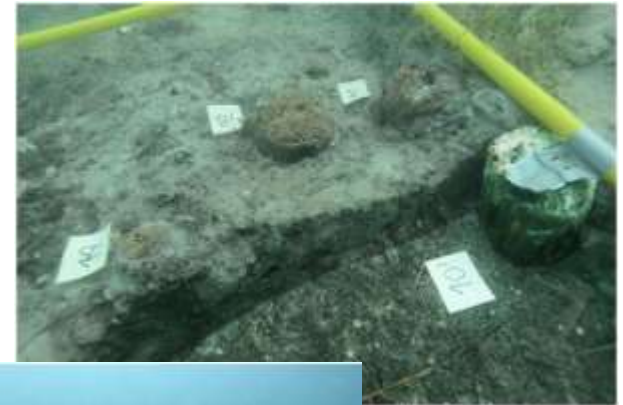


Foto: Henrik Pohl,
Kuratorium
Pfahlbauten,
www.pfahlbauten.at

Test environment

Test sites R1 - R3:

- different water depth (1m – 65m)
- different topography (rough, smooth, flat area)

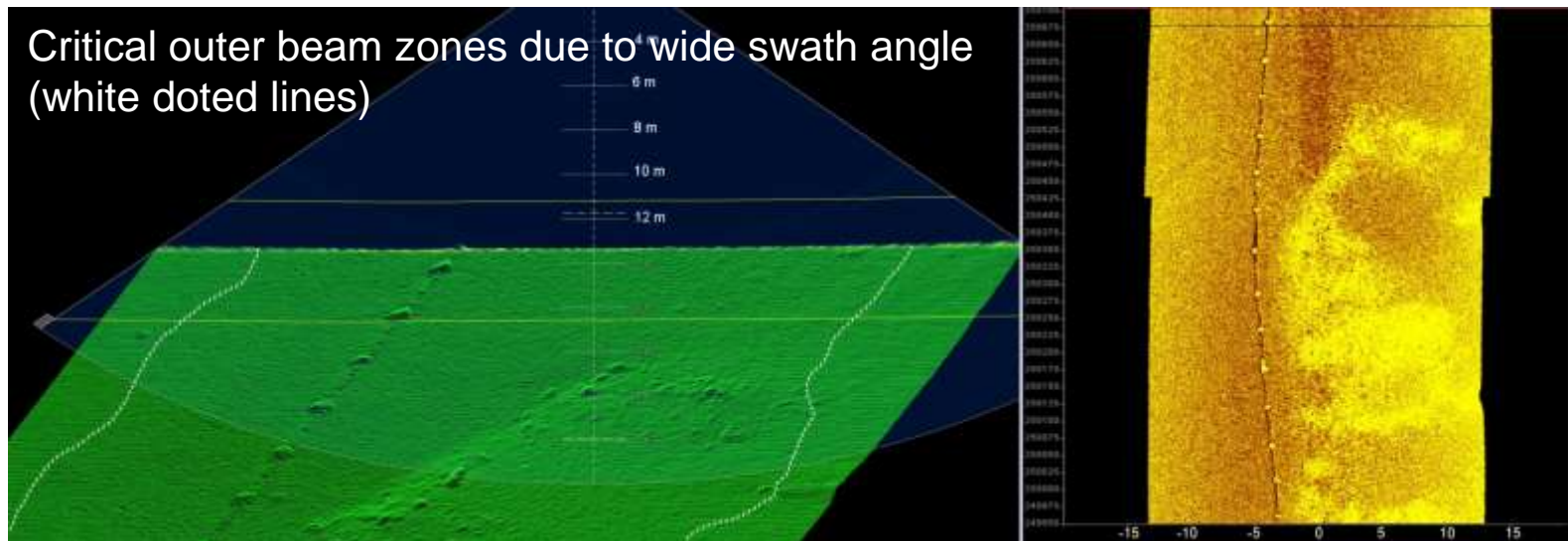


Sensors

- Positioning and Motion: HYDRINS (iXBLUE); AsteRx-U (Septentrio); GS25 (Leica)
- Multibeam Echo Sounder (MBES):
EM2040C (Kongsberg), Sonic 2024 (R2Sonic), SeaBat T50-P (Teledyne Reson)
- Sediment Echo Sounder:
Parametric Sub-Bottom-Profiler SES-2000 Quattro (Innomar)
- Data acquisition, navigation and processing: QINSy (QPS) & manufacturer SW

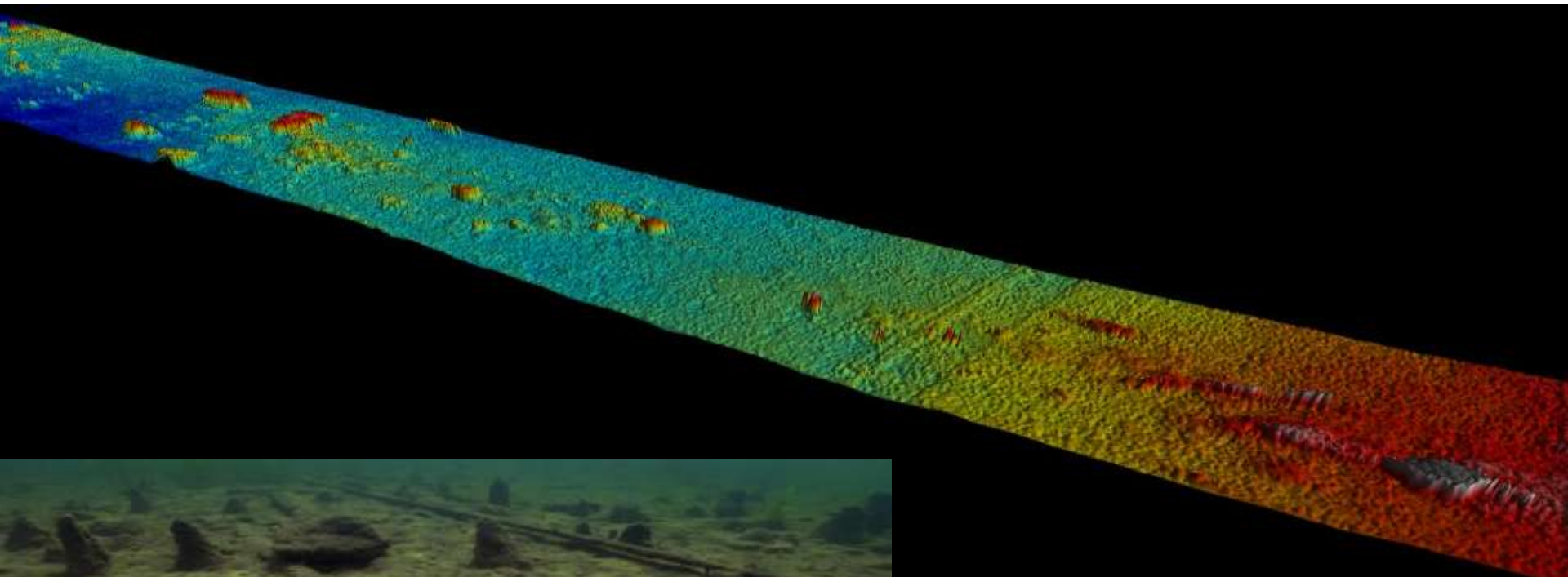
Multi beam measurements (region 3 & 2)

- region R3: prospection of unexplored lake portions incl. “low quality” backscatter and water column data (WCI)
 - ➔ provide further justification to conduct detailed prospection (towed SSS ...)
- region R2: evaluate the data quality of the outer beams in relation to water depth and swath angle



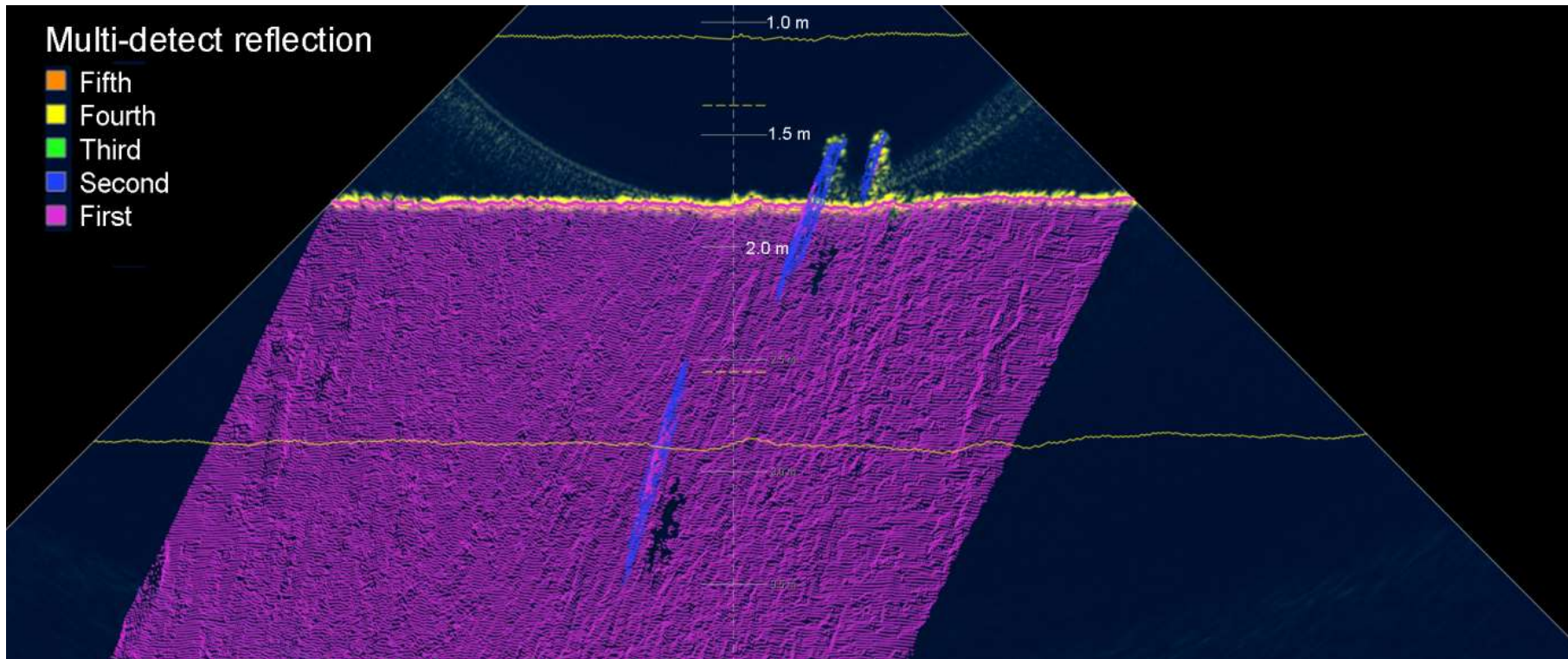
Multi beam measurements (region 1)

- 3 areas: different natural and manmade objects, trenches and remains of wooden piles of the prehistoric settlement
- Acquisition: different frequencies, different swath angles and from different directions by sailing along perpendicular tracks



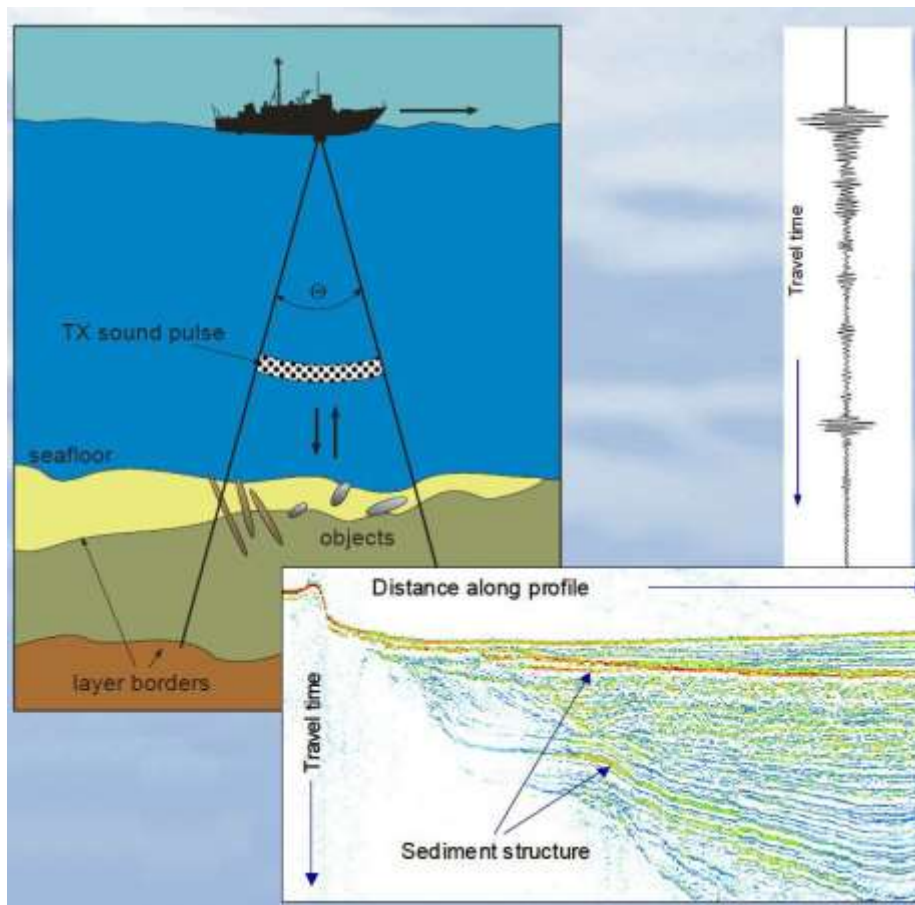
Multi beam measurements (region 1)

- Multi-Detect feature of MBES: provides multiple detections within each beam
- ➔ a pile sticking out of the ground may be represented by several points out of one beam



Parametric sub-bottom profiler (SBP) measurements

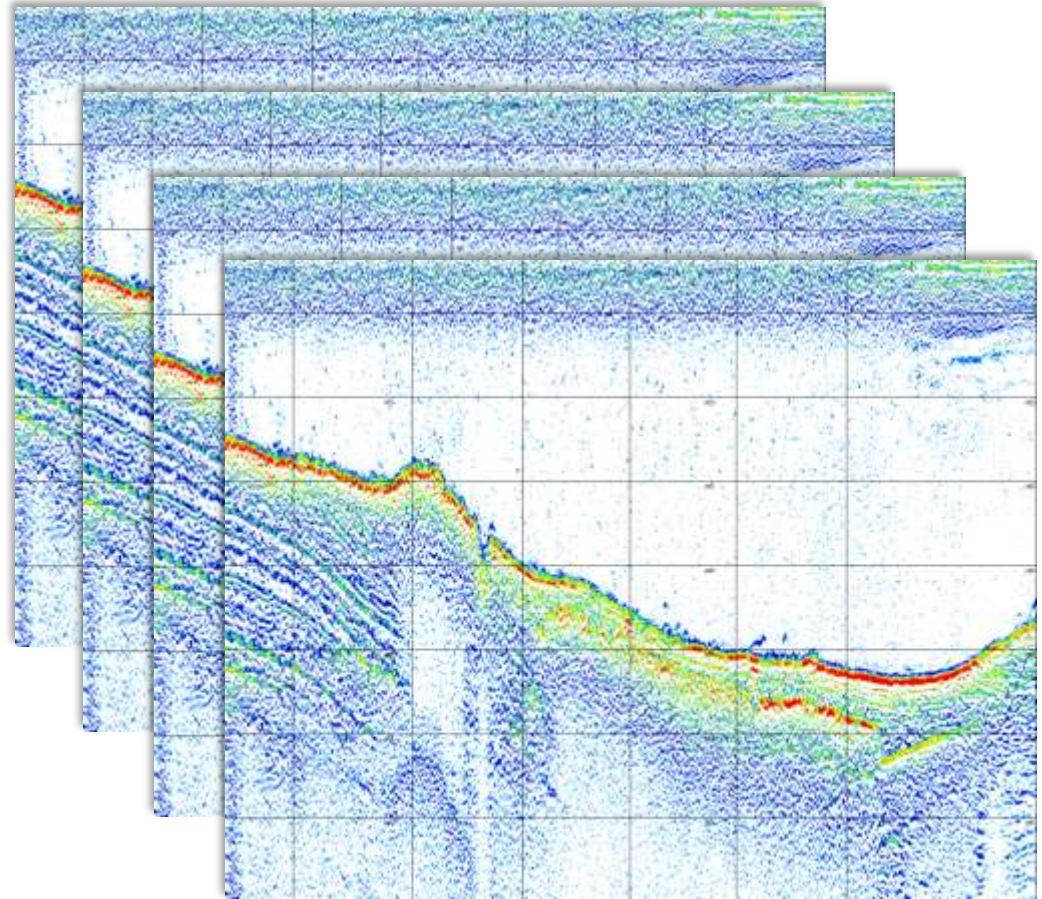
detection of embedded objects, i.e. buried remains of piles



- $\Theta 5^\circ$ at depth 3m \rightarrow footprint $\Phi 0,24\text{m}$
- **Additional information needed** to associate signal reflection to structures
 - Cores
 - archaeological section (trench)
 - ...
 - **Volumetric SBP information**

Multi-transducer parametric SBP

SES-2000 Quattro of Innomar



4 individual SBP transducer
distance: 25 cm

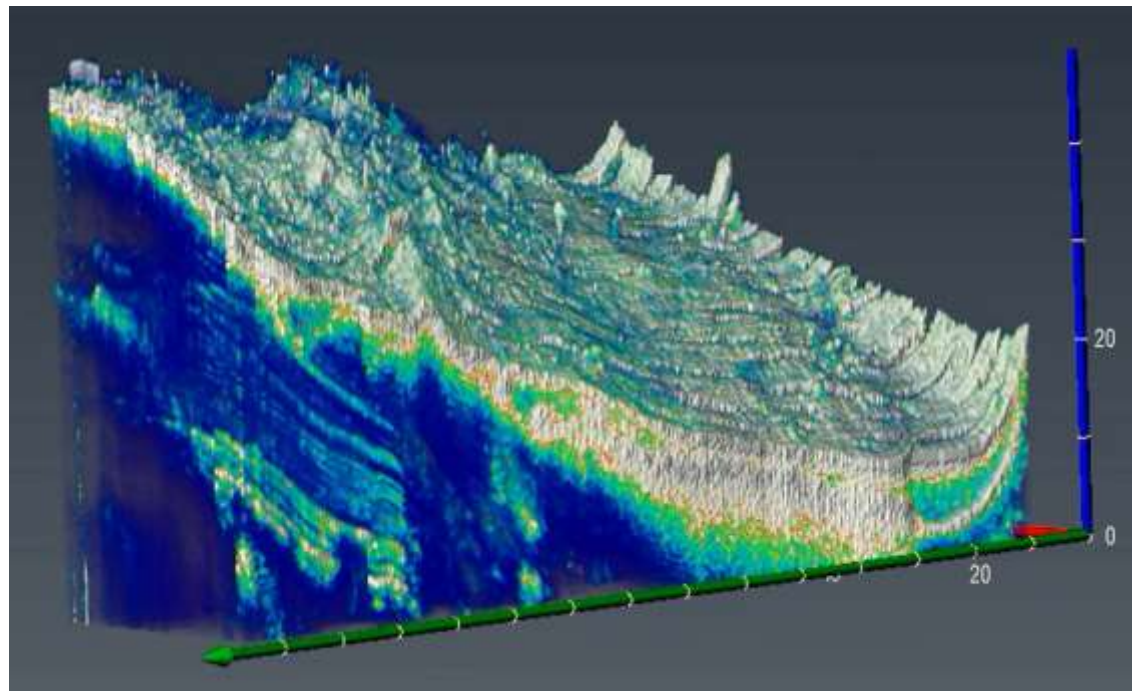
Voxel model of the lake bed of the prehistoric pile dwelling

- 40 tracks of 120 m length sailed (160 sub bottom profiles)
- 25 cm across track distance



→ Voxel-Modell

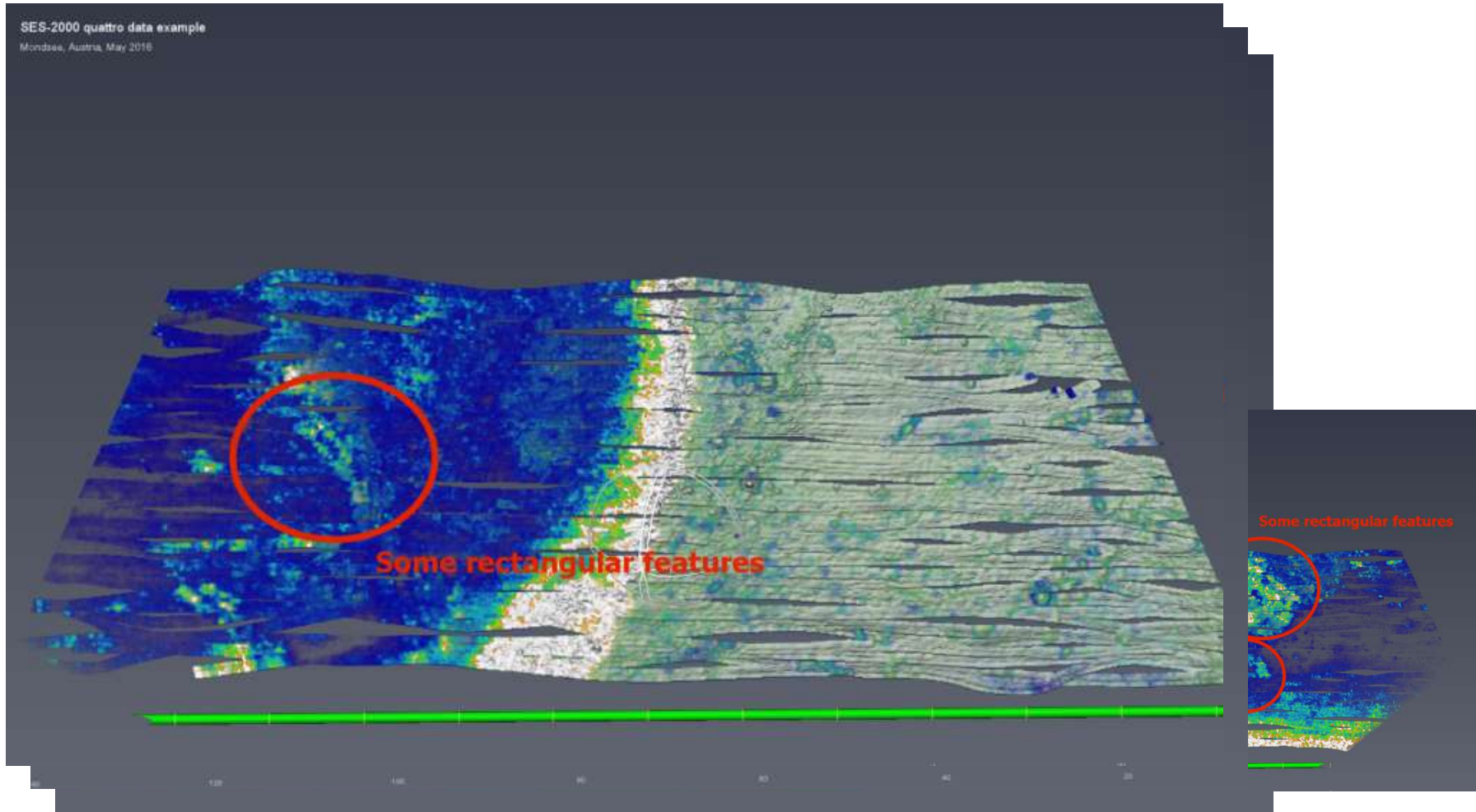
XYZA grid of 12,5cm x 12,5cm x 1cm



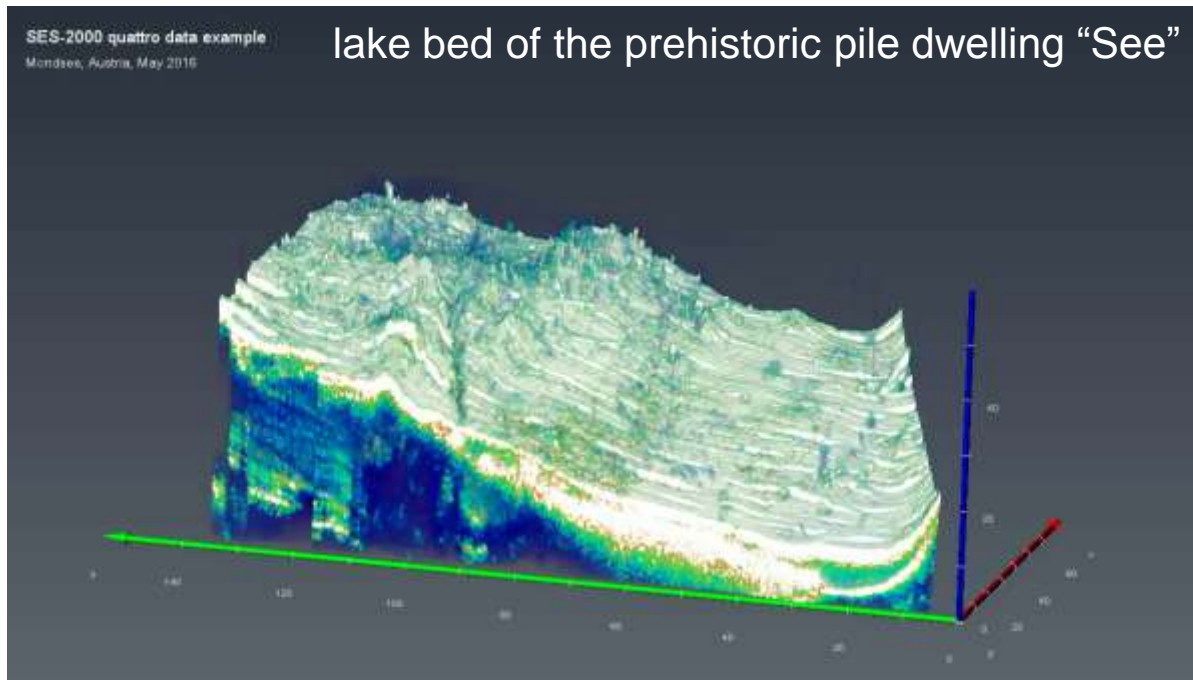
3D interpretation of structures and embedded objects:

“time slices”

applying clip planes at different heights



3D interpretation of structures and embedded objects: “dynamic visualization”



Conclusion

multi-transducer sub-bottom-profiler

- is able to provide detailed and accurate information of structures and objects embedded in sediments
- resulting voxel model offers possibilities for 3D acoustic investigation of the sediment submerged archaeological sites

Thank you for your attention