EGU General Assembly 2020

iXblue

Imaging Lake Altaussee sub-bottom using iXblue Echoes 10 000 and Delph Seismic Software

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, Damien Leloup, Philippe Alain, Emmanuel Chapron

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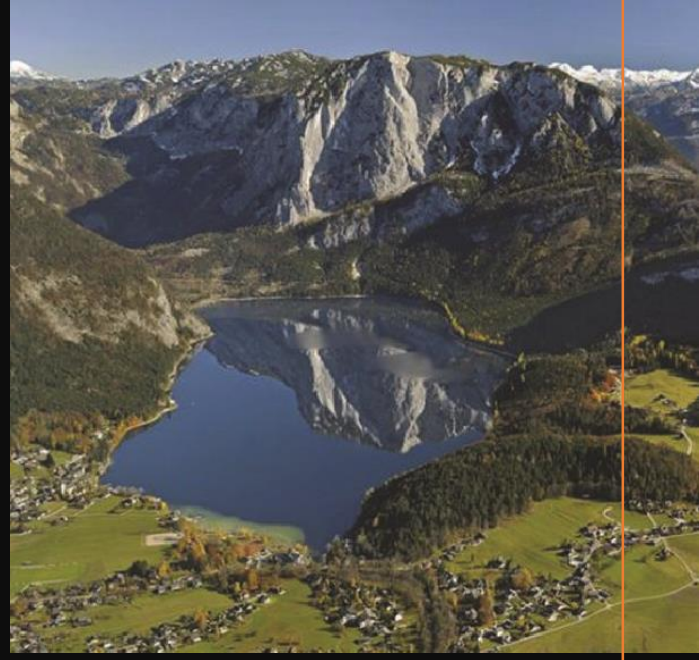
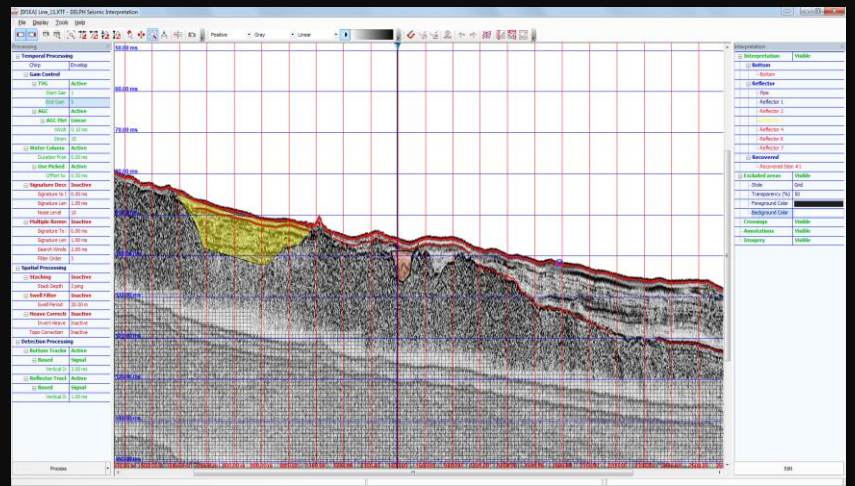


Summary

1. Interest of sub-bottom profiling Altaussee Lake
2. Methods: geophysics & 3D modeling
3. Results: Sedimentary dynamics & water resurgence
4. Conclusions

Delph Seismic



Echoes 10 000

1- ECHOES 10K seismic reflexion in Lake Altaussee

a- Interest for Geosciences

- Alpine lake sediments in the critical zone have proven their efficiency to record regional climate variability and geohazard history at several time-scales.

- **However**, the understanding of lake responses to external environmental factors depends on a precise knowledge of internal lake functioning.

- **High resolution imaging of lake sedimentary infill is crucial to unveil internal and external factors impacting sedimentary processes.**

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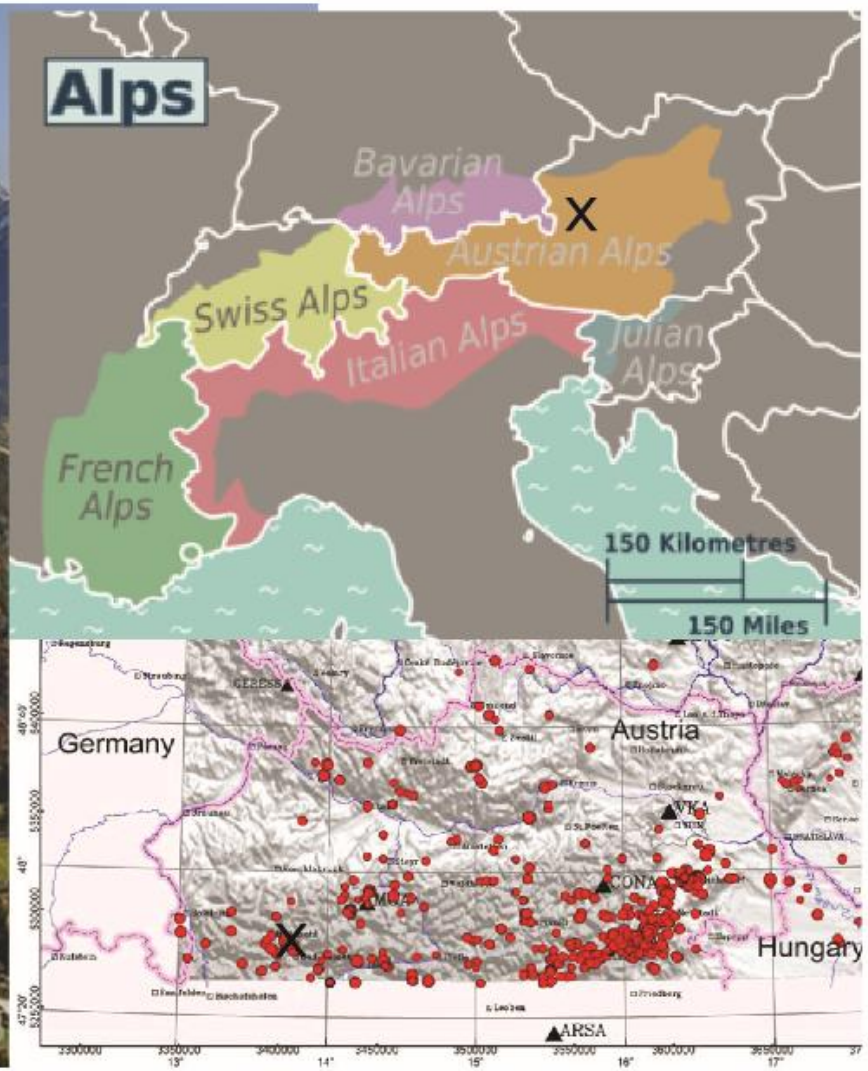
1- ECHOES 10K seismic reflexion in Lake Altaussee

b- Geological settings & Challenges: Earthquakes

- Alt: 712 m
- Dim: 2.6 x 1 km
- Water depth : 53 m max

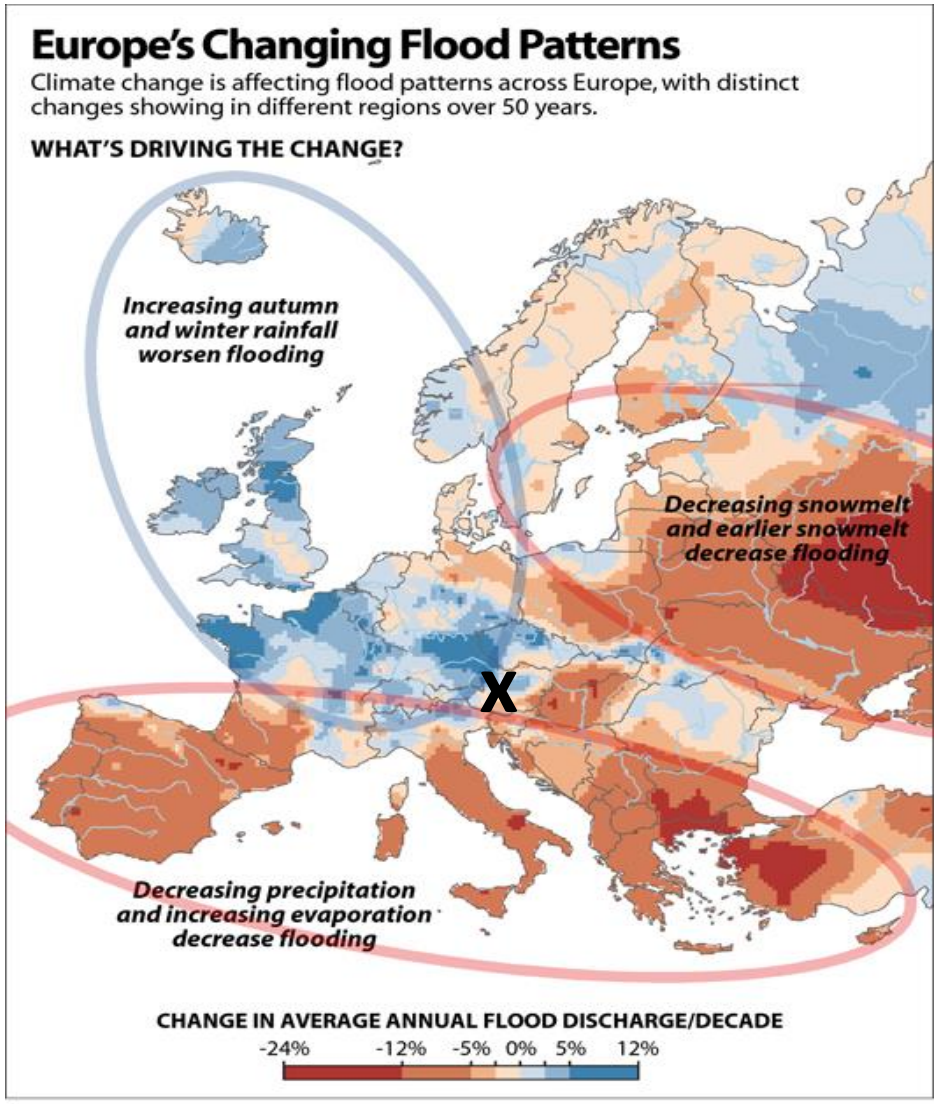


1- ECHOES 10K seismic reflexion in Lake Altaussee

c- Geological settings & Challenges: Floods

Divergent changes in European flood patterns in the last 50 years.

Key region to test models & to improve flood risk management

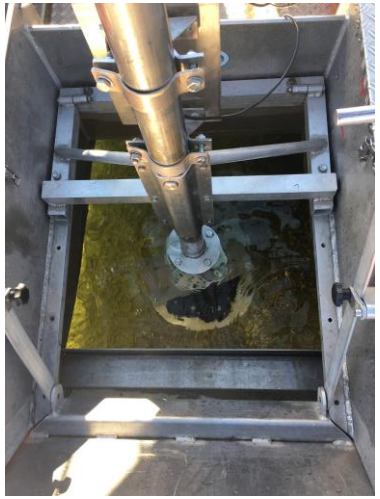


Blöschl et al. 2019, Nature

2- Methods

a- iXblue Sub-bottom profiler

Echoes 10 000



Pole mounted

Amplifier 2 kVA

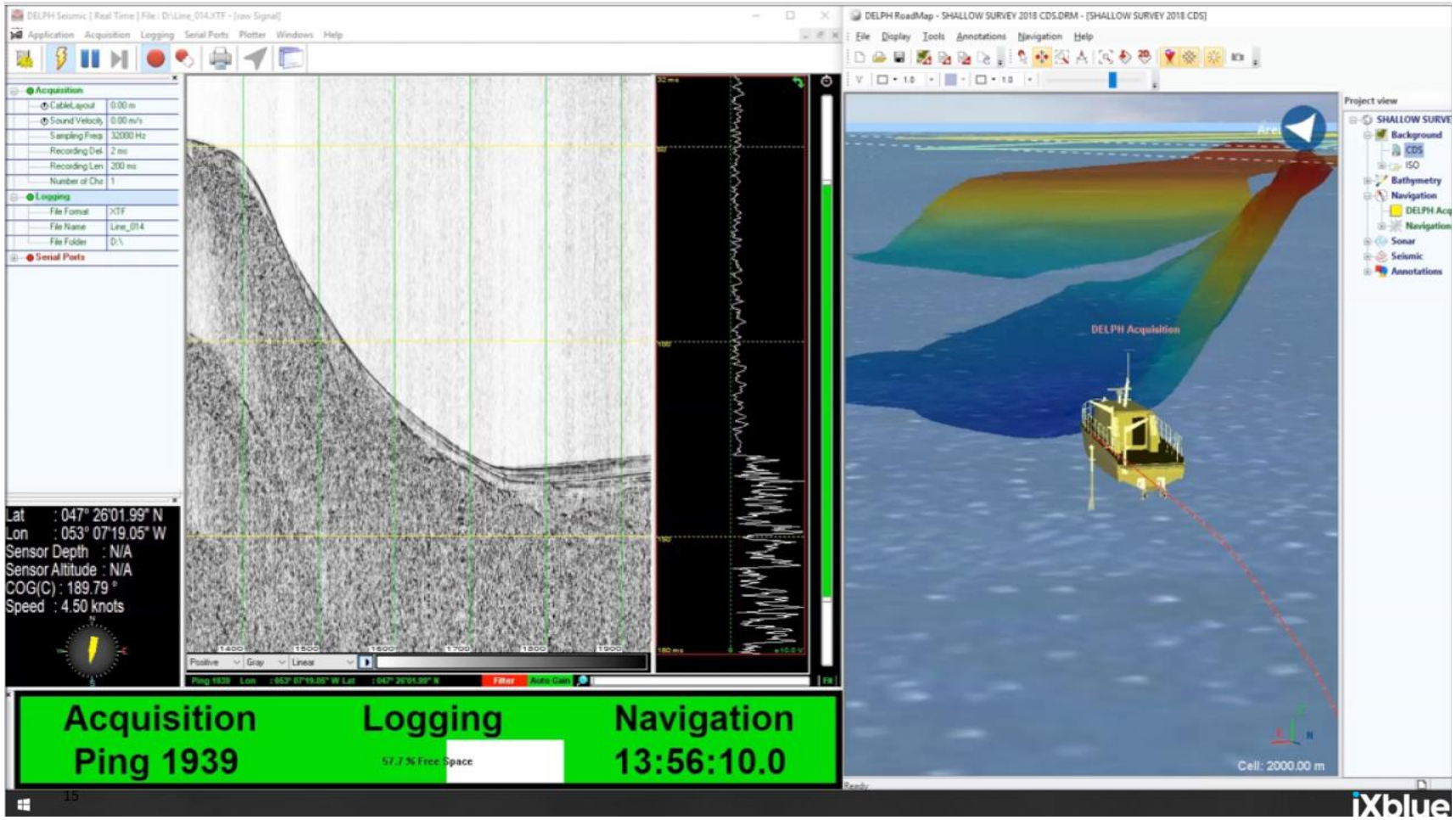
Laptop

GNSS

2- Methods

b- iXblue Delph Seismic Software (acquisition & interpretation)

Delph Seismic allows real-time observation of the seismic reflexion data !



An example from the shallow water survey conference (2018) in Newfoundland using Echoes SBP & Delph

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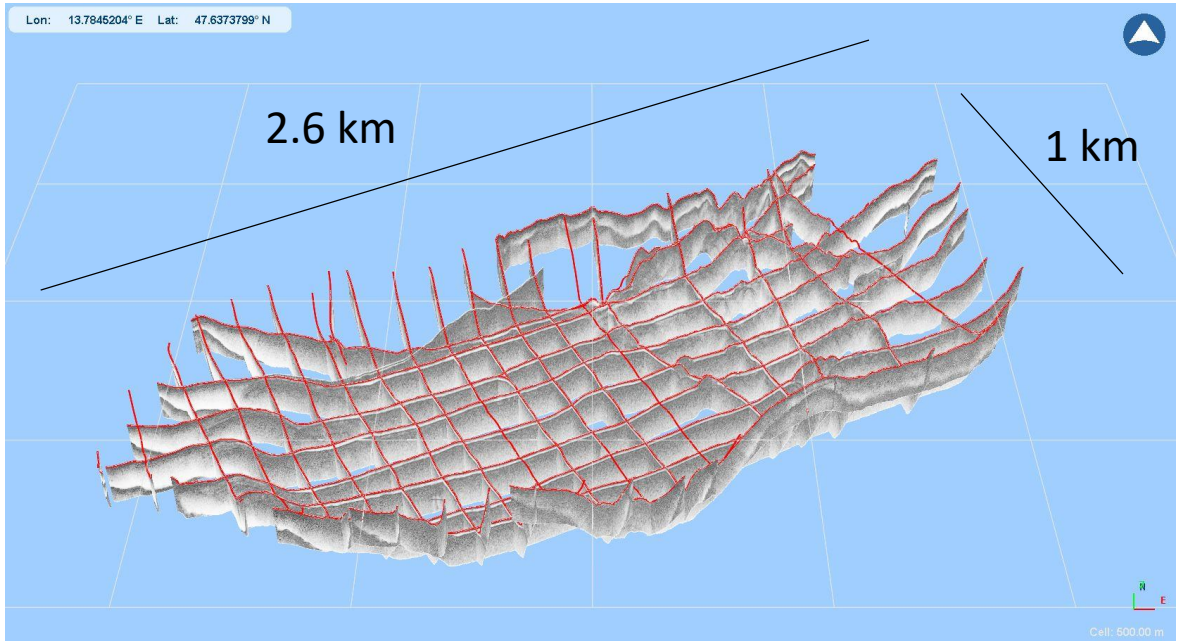
2- Methods

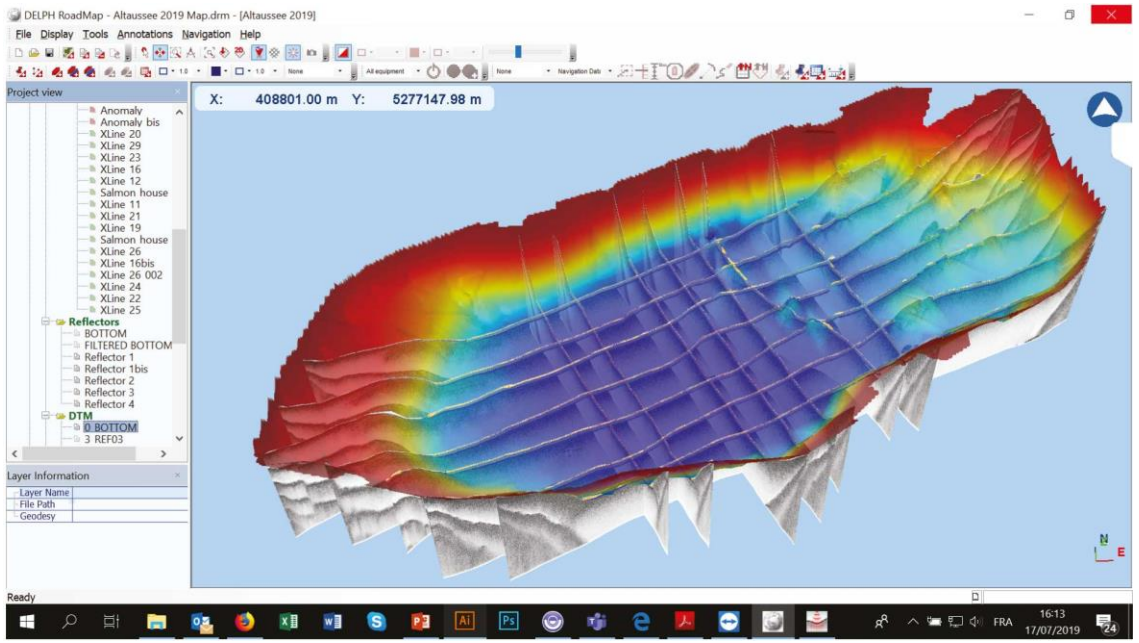
b- iXblue Delph Seismic Software (acquisition & interpretation)

Delph Seismic allows real-time observation of the seismic reflexion data !

ECHOES 10 000 : 29 survey lines



Bathymetry derived from bottom detection



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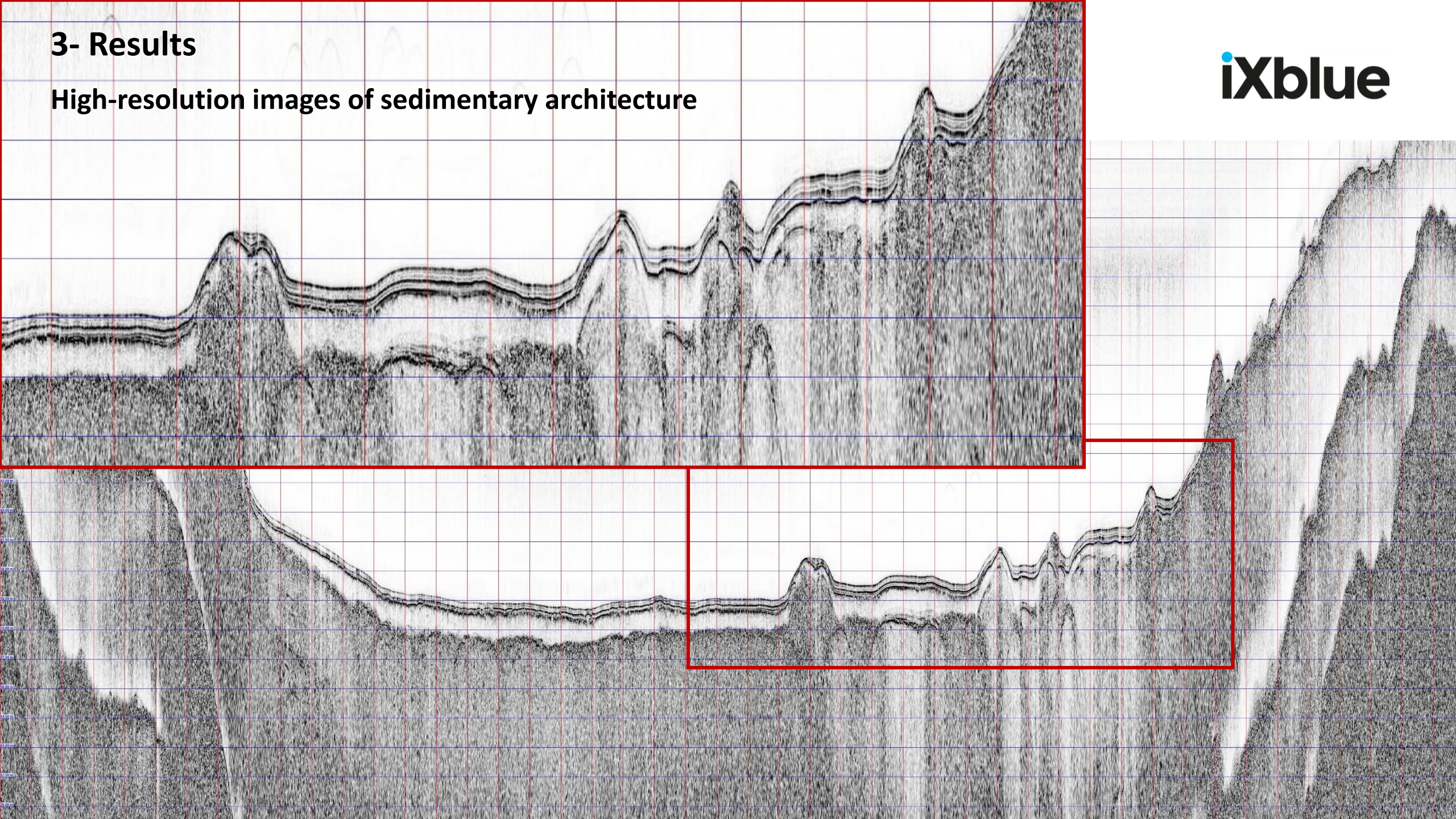
3- Results

High-resolution images of sedimentary architecture

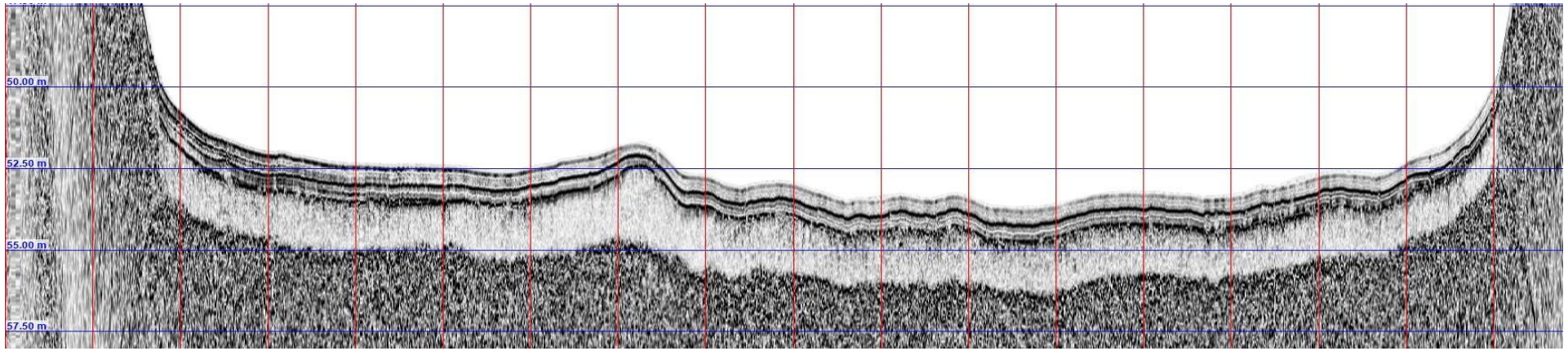


3- Results & Discussion

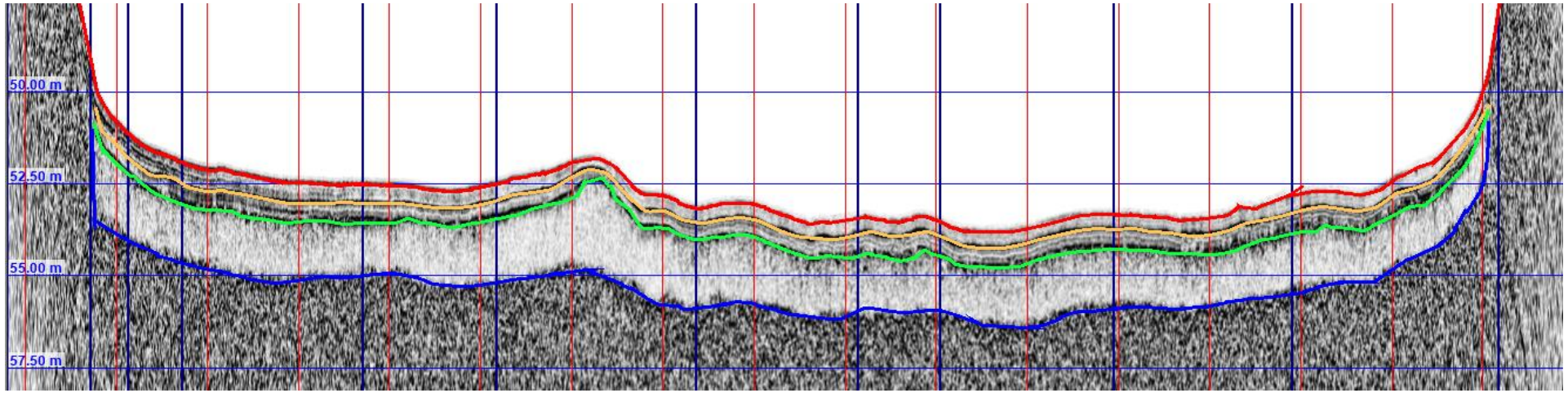
a- Sedimentary dynamic analyses

4 main reflectors (acoustic impedance variations)

- Bottom
- 3 different sediment layers & depositional modes
- Bedrock



Automatic or manuel reflectors marking



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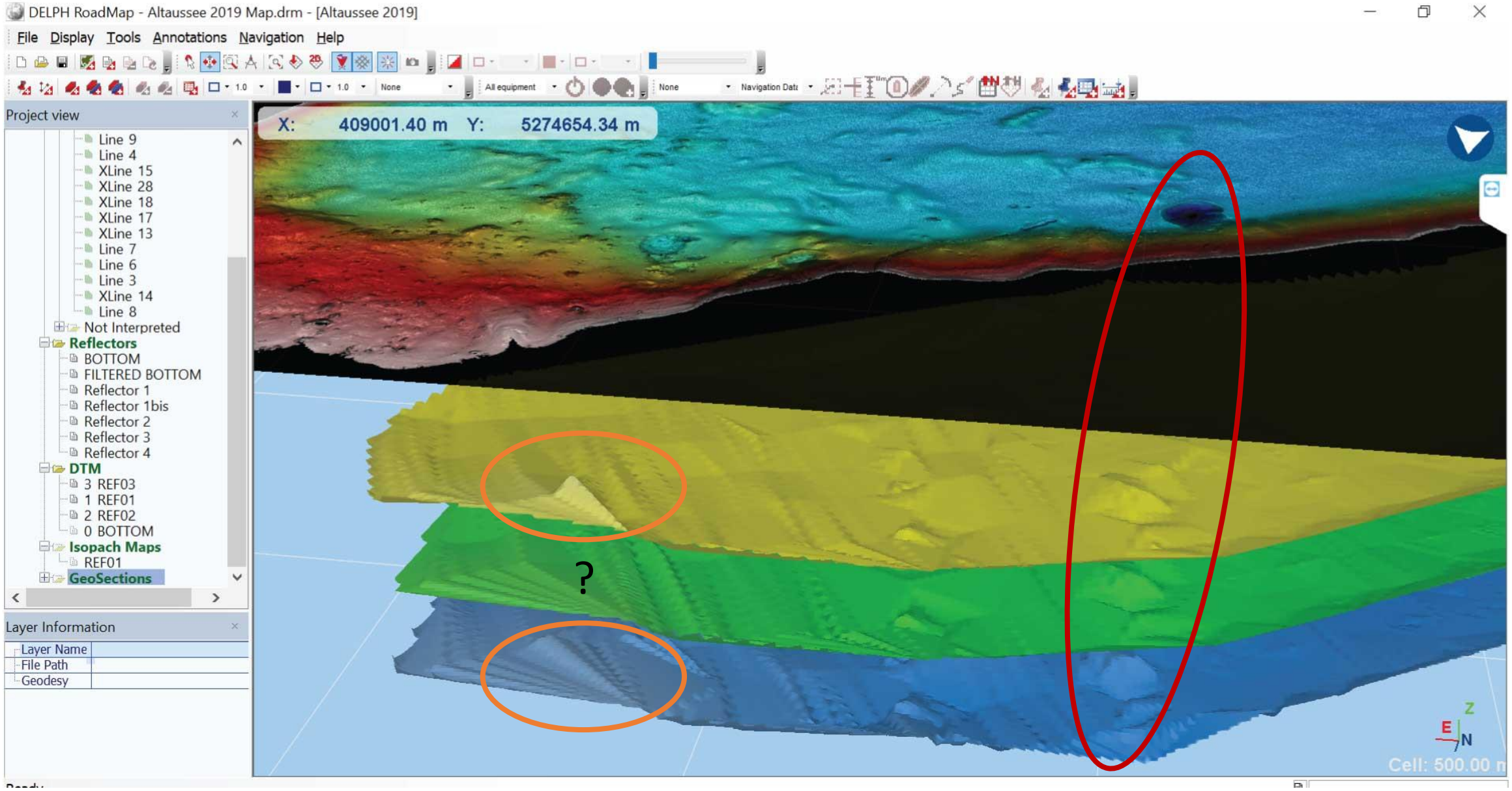
3- Results & Discussion

a- Sedimentary dynamic analyses: isopach of main layers



3- Results & Discussion

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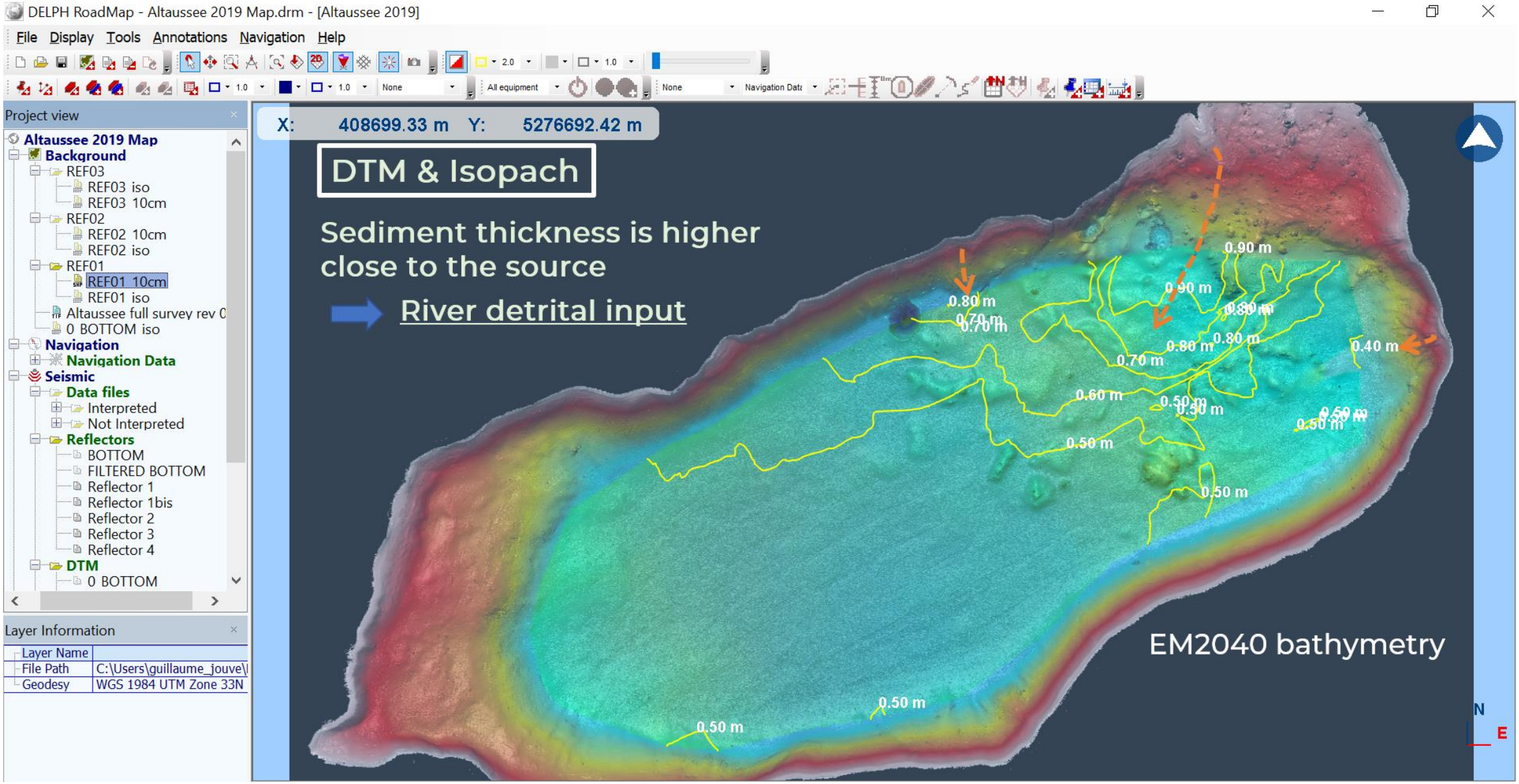

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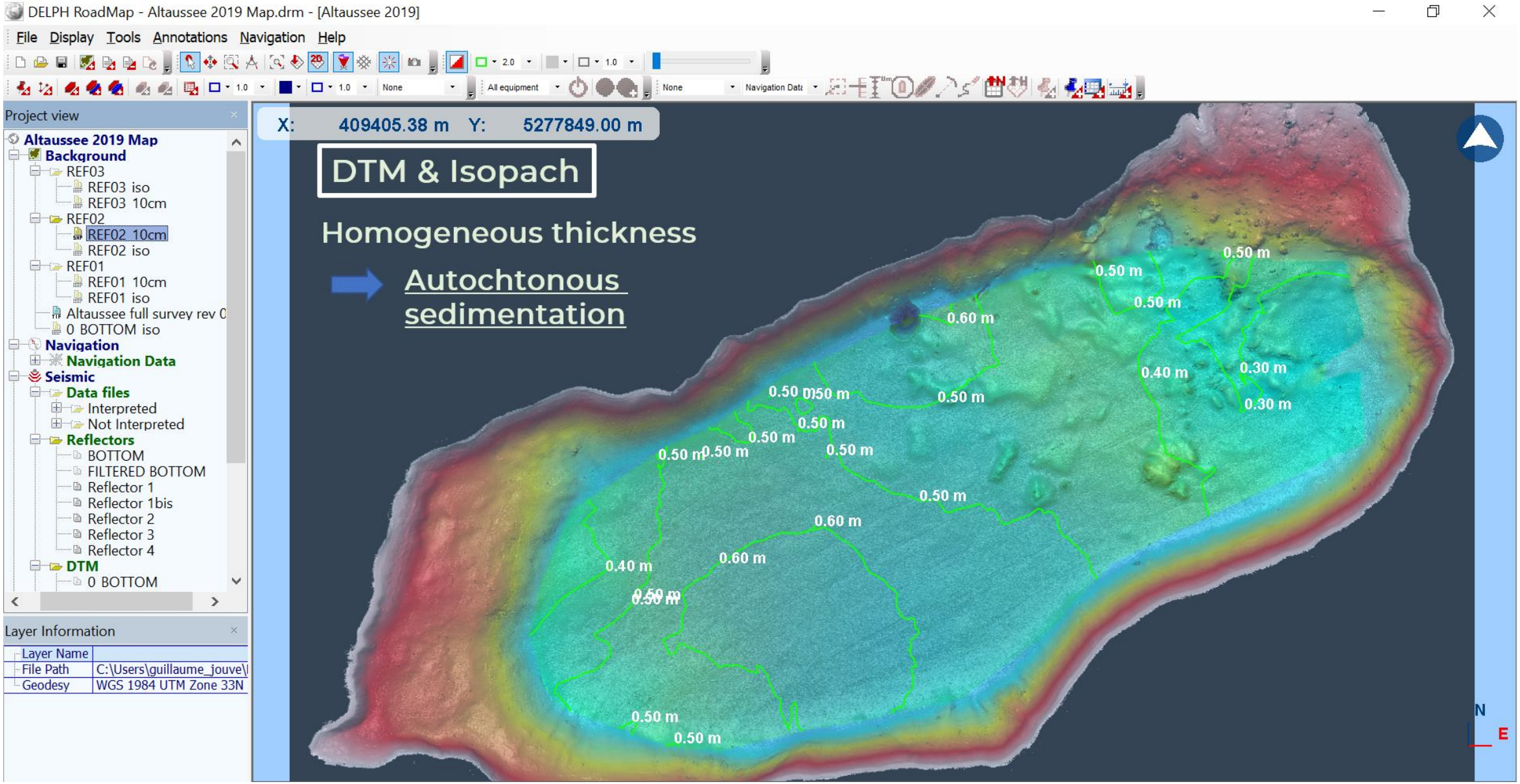

3- Results & Discussion

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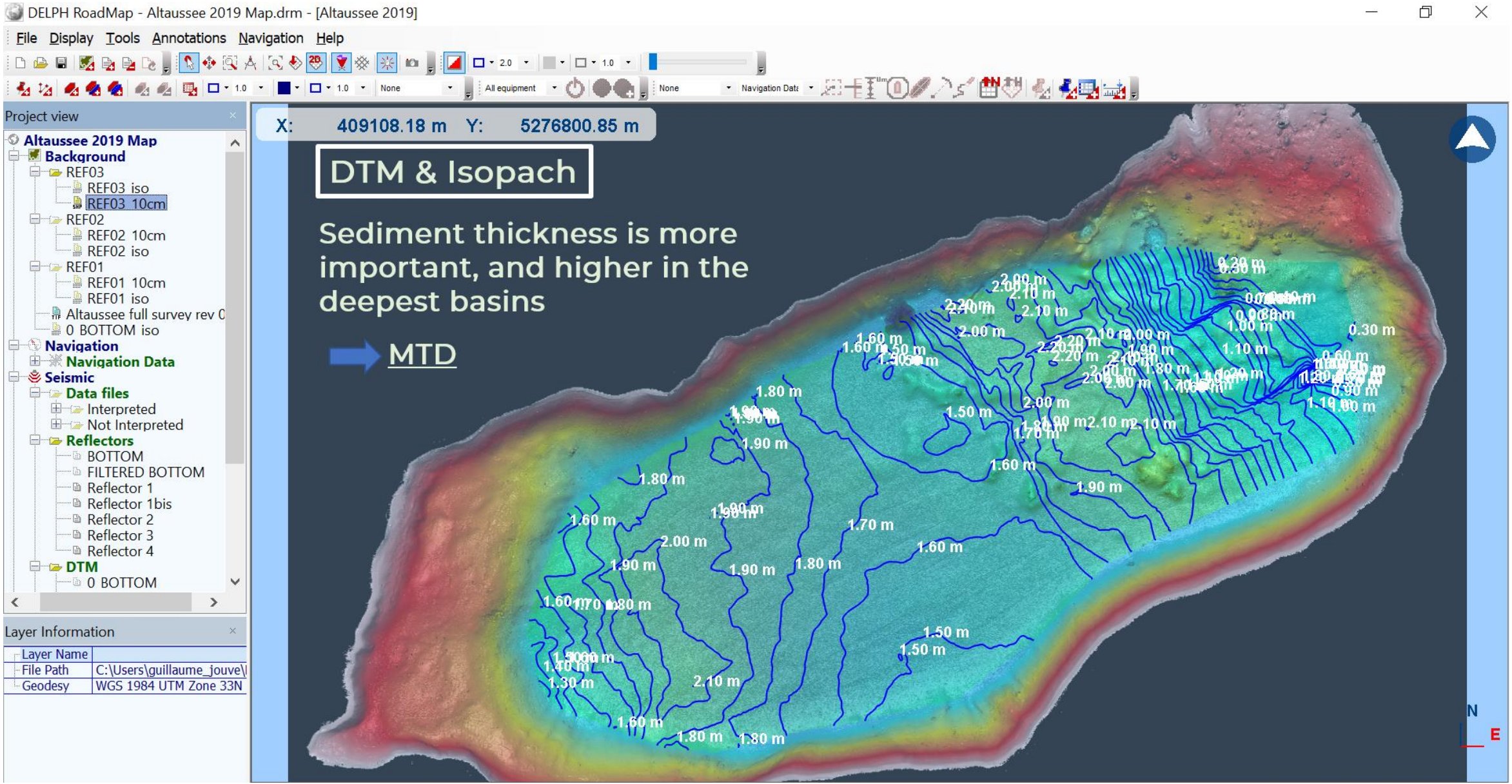
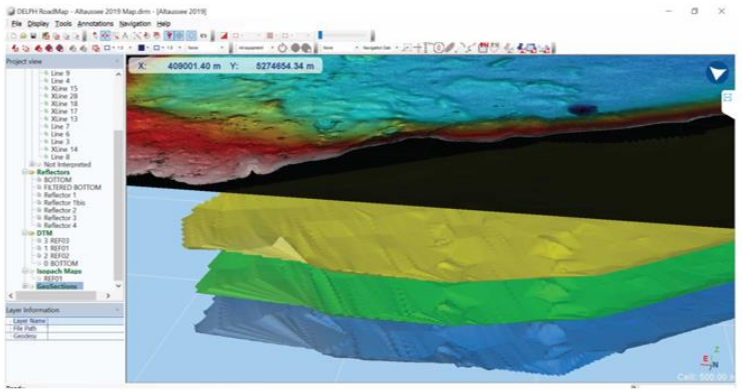
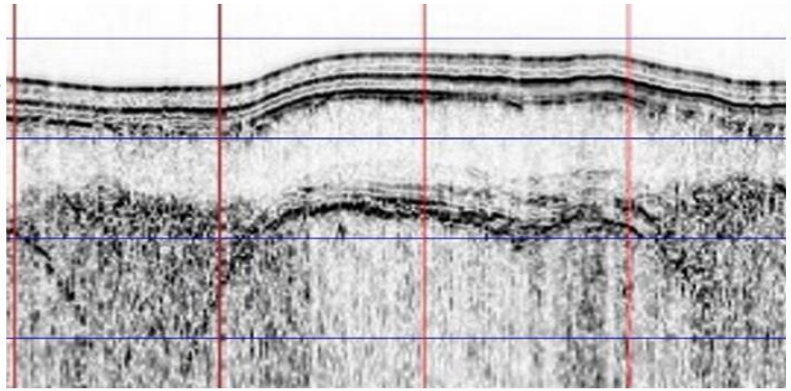


3- Results & Discussion

a- Sedimentary dynamic analyses: Volume calculations





Interpretations
Sediment Volumes

Volume report

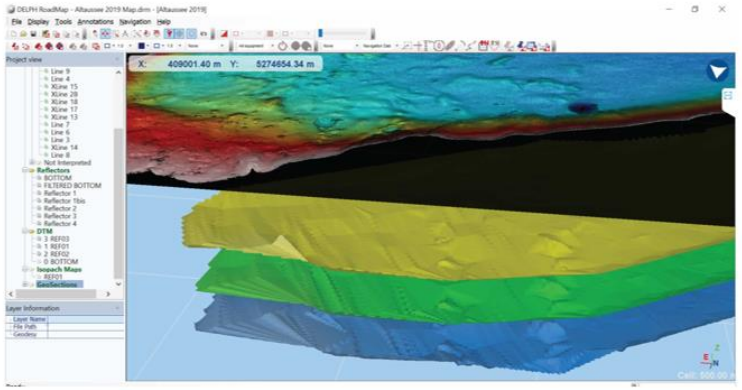
Source File Information	
File Name	REF01
File Path	D:\DATA\3_IXBLUE\ECHOES\2019-05-01 ECHOES 10000 Altaussee\Altaussee-Isopach-Nov-2019\ISOPACH\REF01.XMD
Date	Wednesday, July 17, 2019
Geodesy	WGS 1984 UTM Zone 33N (12°E - 18°E)
Bounding Box	N: 5278660.000 (m) S: 5277610.000 (m) W: 407990.000 (m) E: 409720.000 (m)
Extent	Northing: 1050.000 (m) Easting: 1730.000 (m)
Computational Results	
Cells	43560
Cell Surface	25.000 m^2
Total Surface	1089000.000 m^2
Volume	558646.639 m^3
Min Thickness	0.385 m
Max Thickness	0.994 m

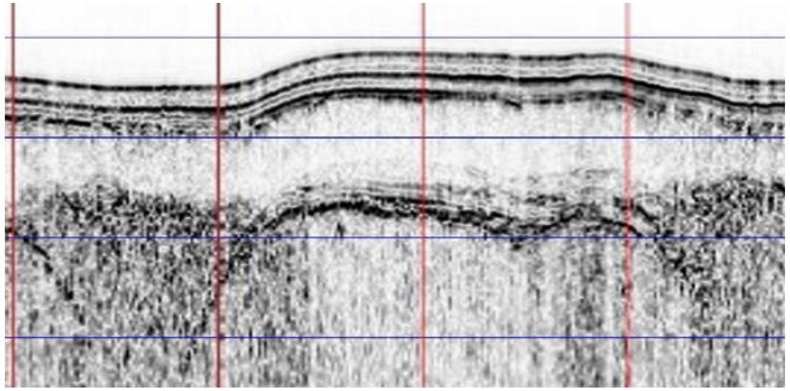
Automatic report generated by iXBlue DELPH Sonar Software
jeudi 7 novembre 2019 14:59:39

iXblue

3- Results & Discussion

a- Sedimentary dynamic analyses: Volume calculations





Sediment Volumes

Volume report

Source File Information	
File Name	REF02
File Path	D:\DATA\3_IXBLUE\ECHOES\2019-05-01 ECHOES 10000 Altaussee\Altaussee-Isopach-Nov-2019\ISOPACH\REF02.xmd
Date	Wednesday, July 17, 2019
Geodesy	WGS 1984 UTM Zone 33N (12°E - 18°E)
Bounding Box	N: 5278660.000 (m) S: 5277610.000 (m) W: 407990.000 (m) E: 409720.000 (m)
Extent	Northing: 1050.000 (m) Easting: 1730.000 (m)
Computational Results	
Cells	43560
Cell Surface	25.000 m^2
Total Surface	1089000.000 m^2
Volume	534899.281 m^3
Min Thickness	0.206 m
Max Thickness	0.650 m

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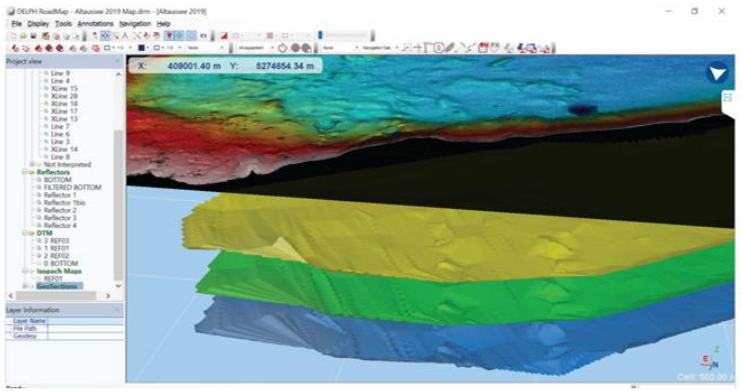
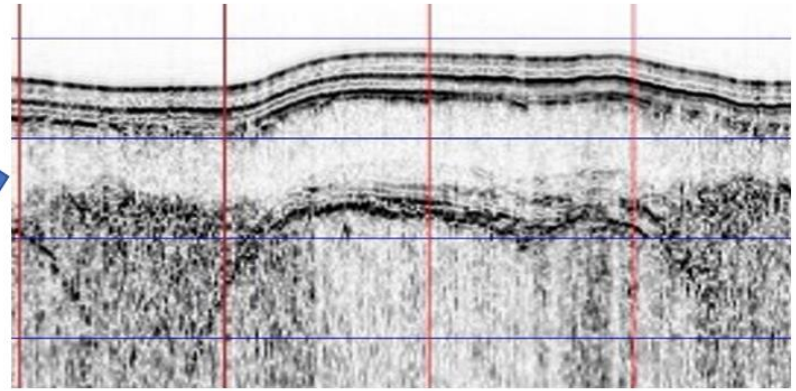
iXblue

3- Results & Discussion

a- Sedimentary dynamic analyses: Volume calculations





Sediment Volumes

Volume report

Source File Information	
File Name	REF03
File Path	D:\DATA\3_IXBLUE\ECHOES\2019-05-01 ECHOES 10000 Altaussee\Altaussee-Isopach-Nov-2019\ISOPACH\REF03.xmd
Date	Wednesday, July 17, 2019
Geodesy	WGS 1984 UTM Zone 33N (12°E - 18°E)
Bounding Box	N: 5278660.000 (m) S: 5277610.000 (m) W: 407990.000 (m) E: 409720.000 (m)
Extent	Northing: 1050.000 (m) Easting: 1730.000 (m)

Computational Results	
Cells	43414
Cell Surface	25.000 m^2
Total Surface	1085350.000 m^2
Volume	1776331.585 m^3
Min Thickness	0.125 m
Max Thickness	2.232 m

x3

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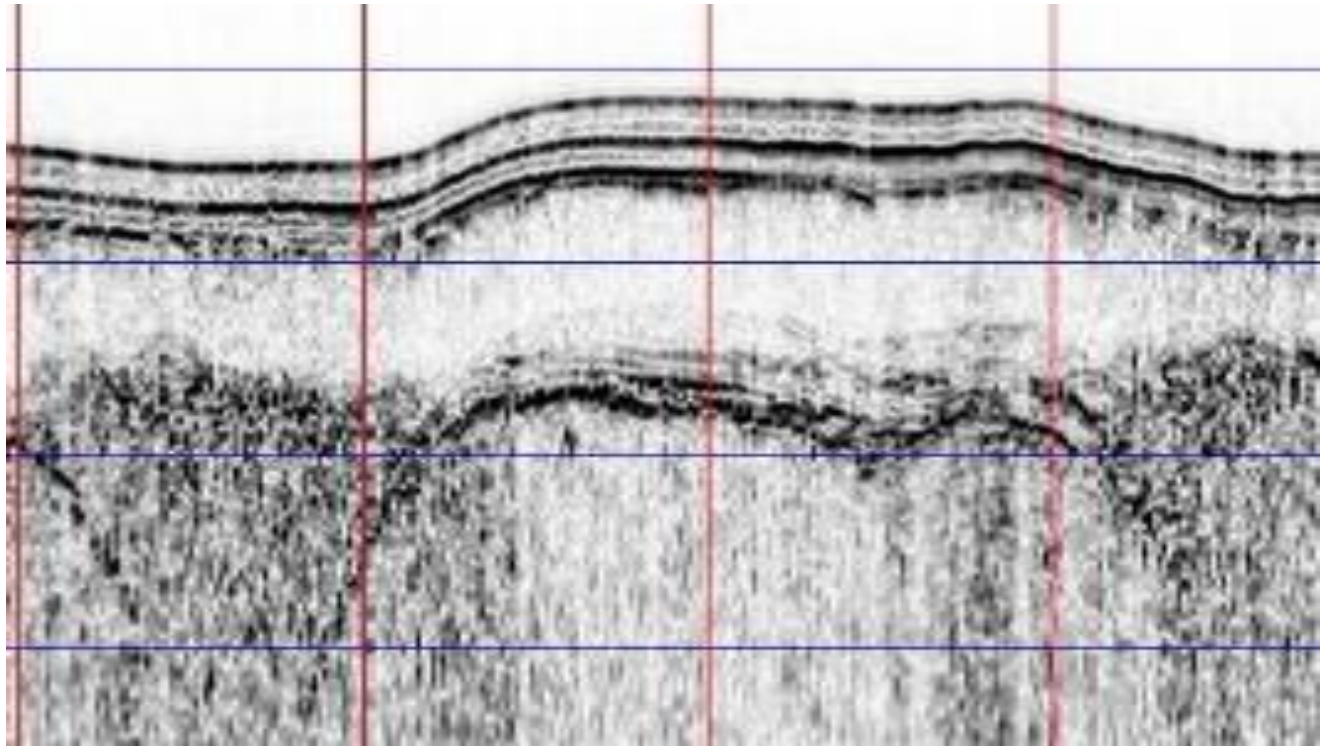
3- Results & Discussion

a- Sedimentary dynamic analyses: Origins ?

- Is it a catastrophic event ?
- Is it linked to an earthquake, flood, rockfall, etc. ?
- Is there any link with the « Mystisches Salzkammergut » Lake Mondsee-tsunami 5000 years ago ?



https://www.salzkammergood.at/tsunami-am-atter-und-mondsee/

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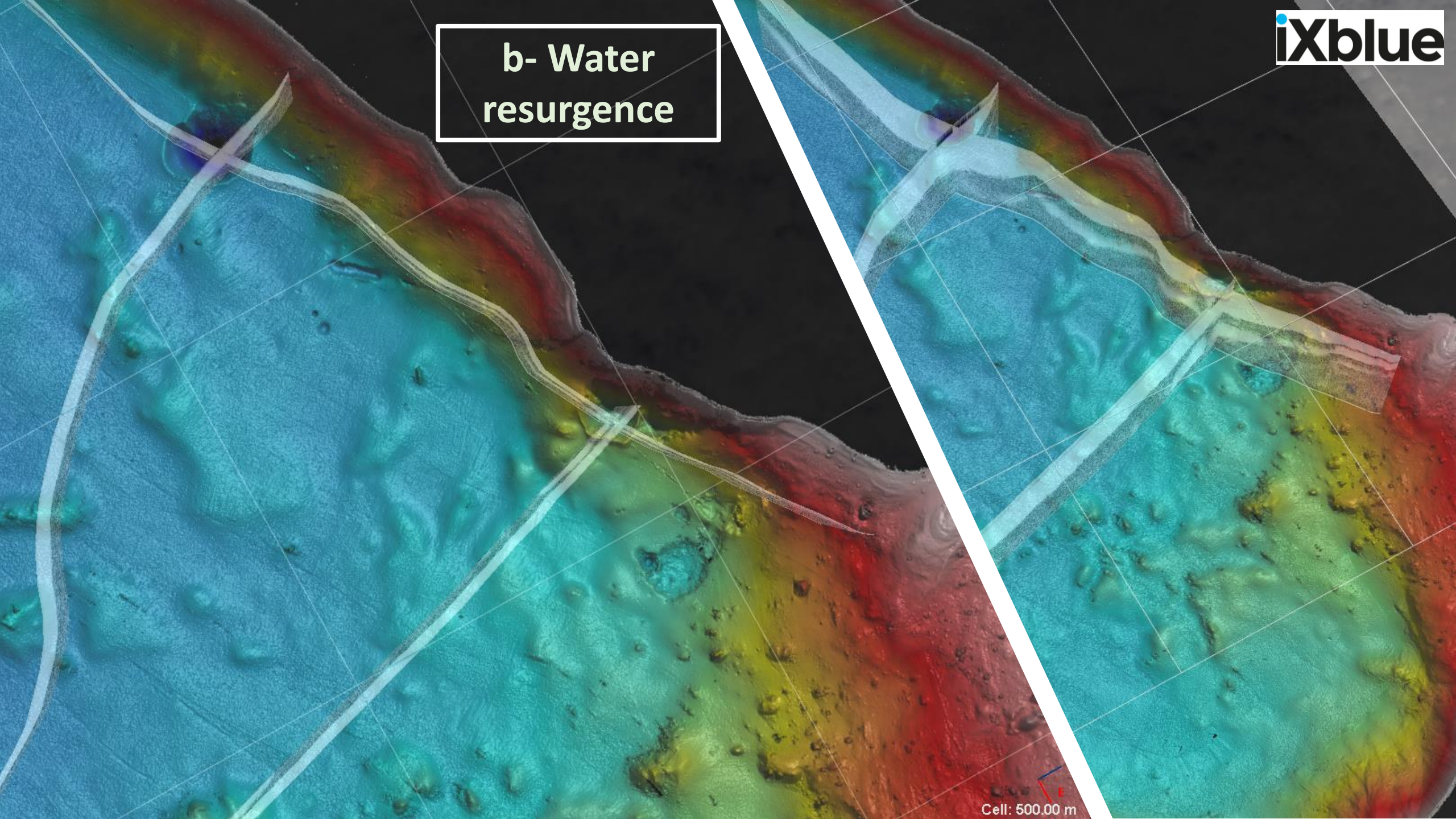
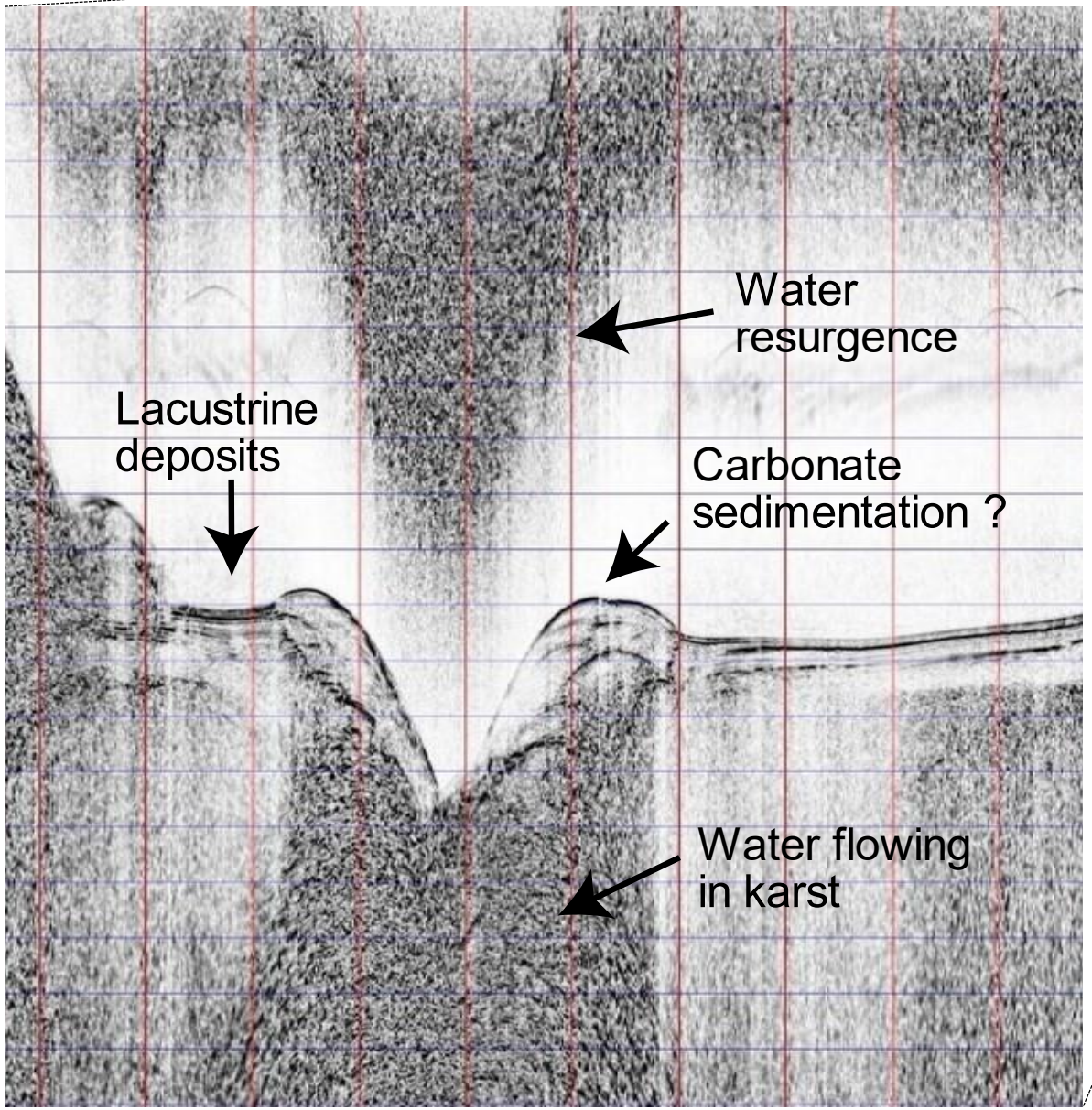
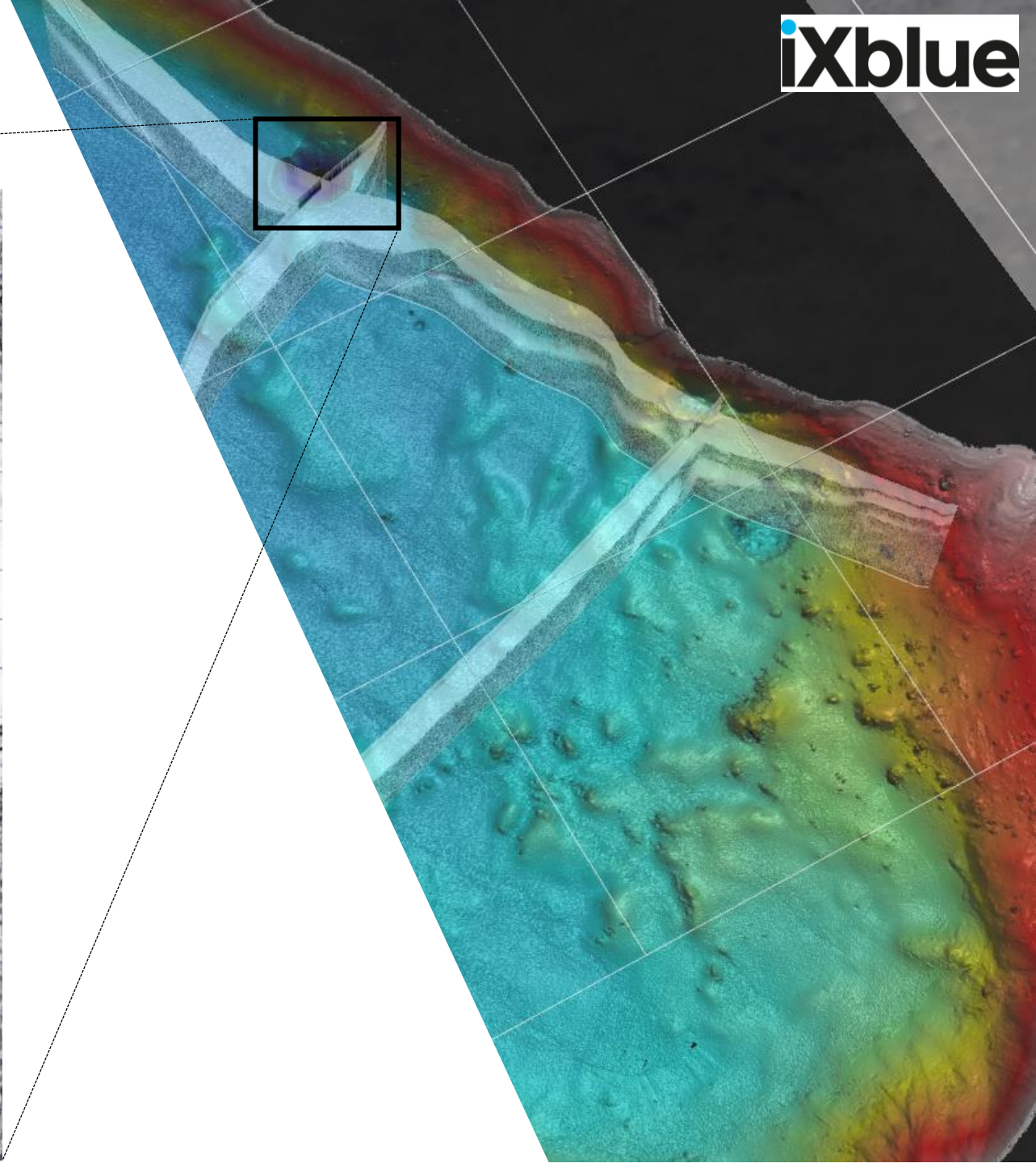

b- Water resurgence
iXblue
Cell: 500.00 m

3- Results & Discussion

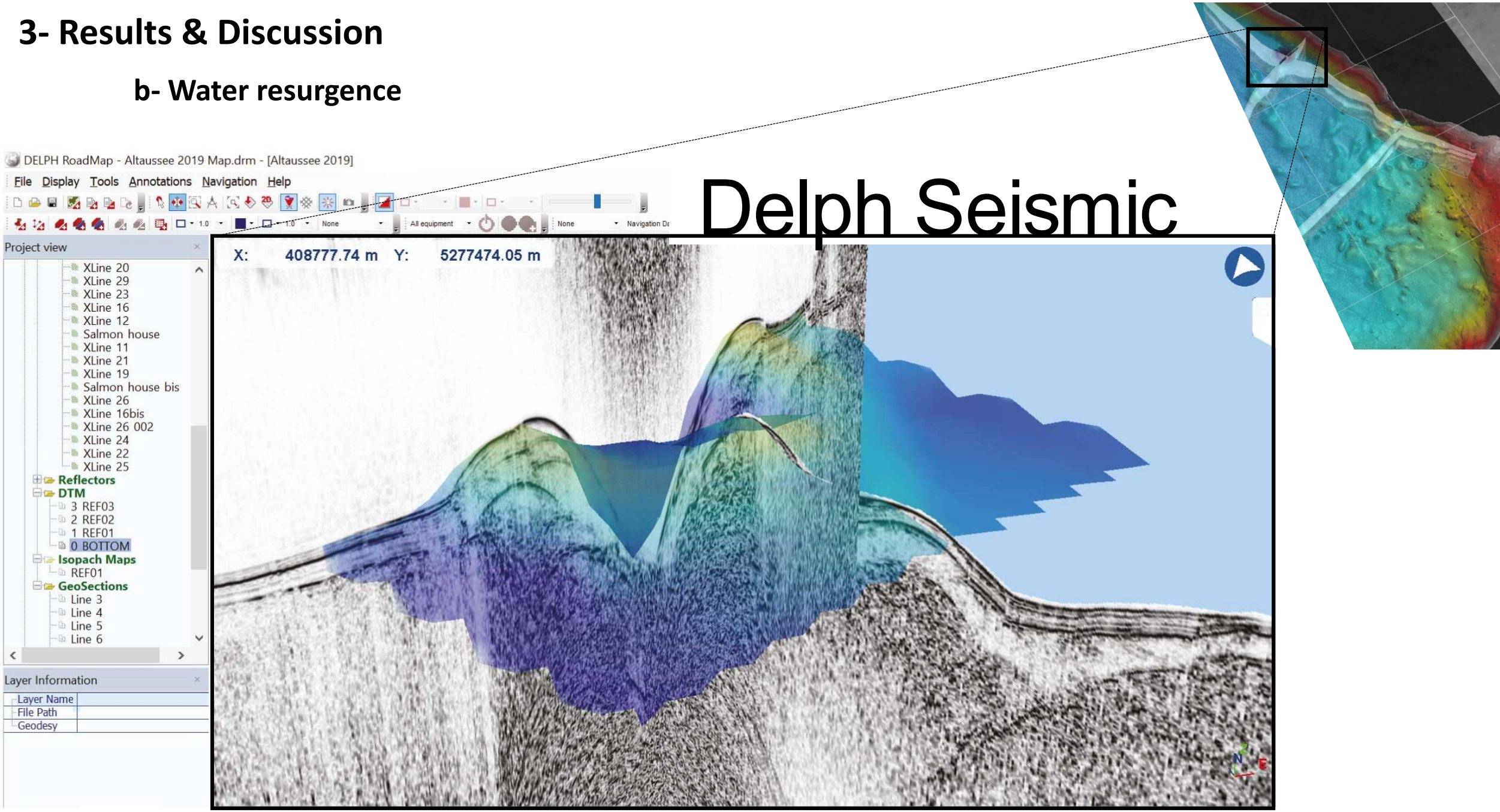
b- Water resurgence





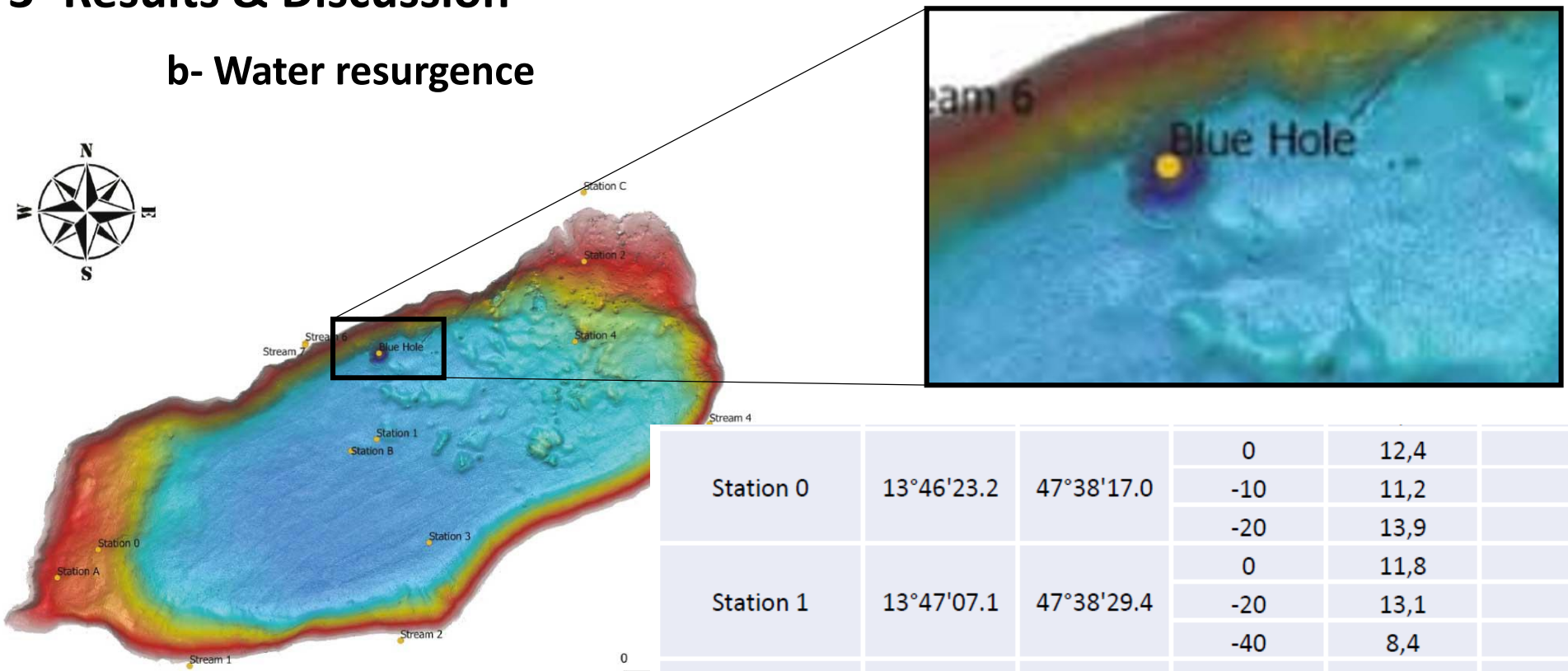
3- Results & Discussion

b- Water resurgence



3- Results & Discussion

b- Water resurgence



Station 0	13°46'23.2	47°38'17.0	0	12,4	100	168	7,9
			-10	11,2	93	163	8,0
			-20	13,9	100	170	8,0
Station 1	13°47'07.1	47°38'29.4	0	11,8	99	168	8,3
			-20	13,1	91	172	8,0
			-40	8,4	90	173	8,0
Station 2	13°47'39.6	47°38'49.0	0	12,6	100	168	8,2
			-10	10,3	100	168	7,9
			-20	14,2	95	167	7,9
Station 3	13°47'15.7	47°38'18.3	0	12,1	100	168	8,3
			-20	10,7	91	167	7,9
			-40	8,2	90	167	7,9
Station 4	13°47'38.3	47°38'40.3	0	10,9	99	168	8,3
			-20	8	90	164	8,0
			-40	7,2	90	166	7,9
Blue Hole	13°47'07.26	47°38'38.70	0	13,6	98	170	8,2
			-62	7	100	157	7,8

Lowest lake salinity

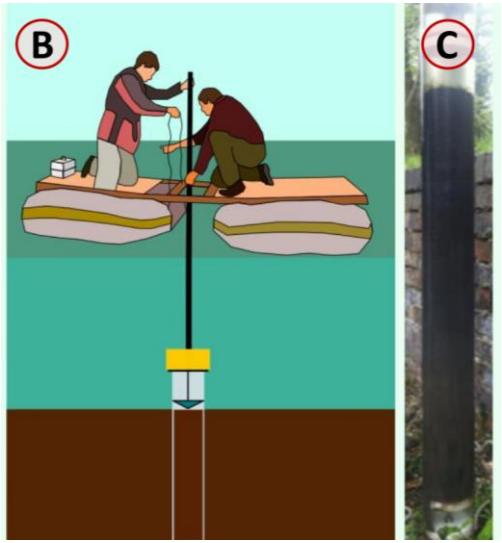
Our methodological approach allows to:

1- Reconstruct sedimentary dynamics using quantitative data

2- Highlights water resurgence

4- Main conclusions & perspectives

Future research will soon provide sedimentological and geochemical analyses of the sediments and propose an age model to unveil the paleoenvironmental history of Altaussee Lake



Cambronero & Orsini, 2018