Evaluating structures and deep geothermal potential of Central Wallonia: results from the GeoCOND2022 seismic reflection campaign

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Interreg North-West Europe DGE-ROLLOUT

Avec le soutien de la Wallonie

Geological Survey of Belgium

UMONS Université de Mons

MEET Multi-sites EGS Demonstration

natural sciences.be

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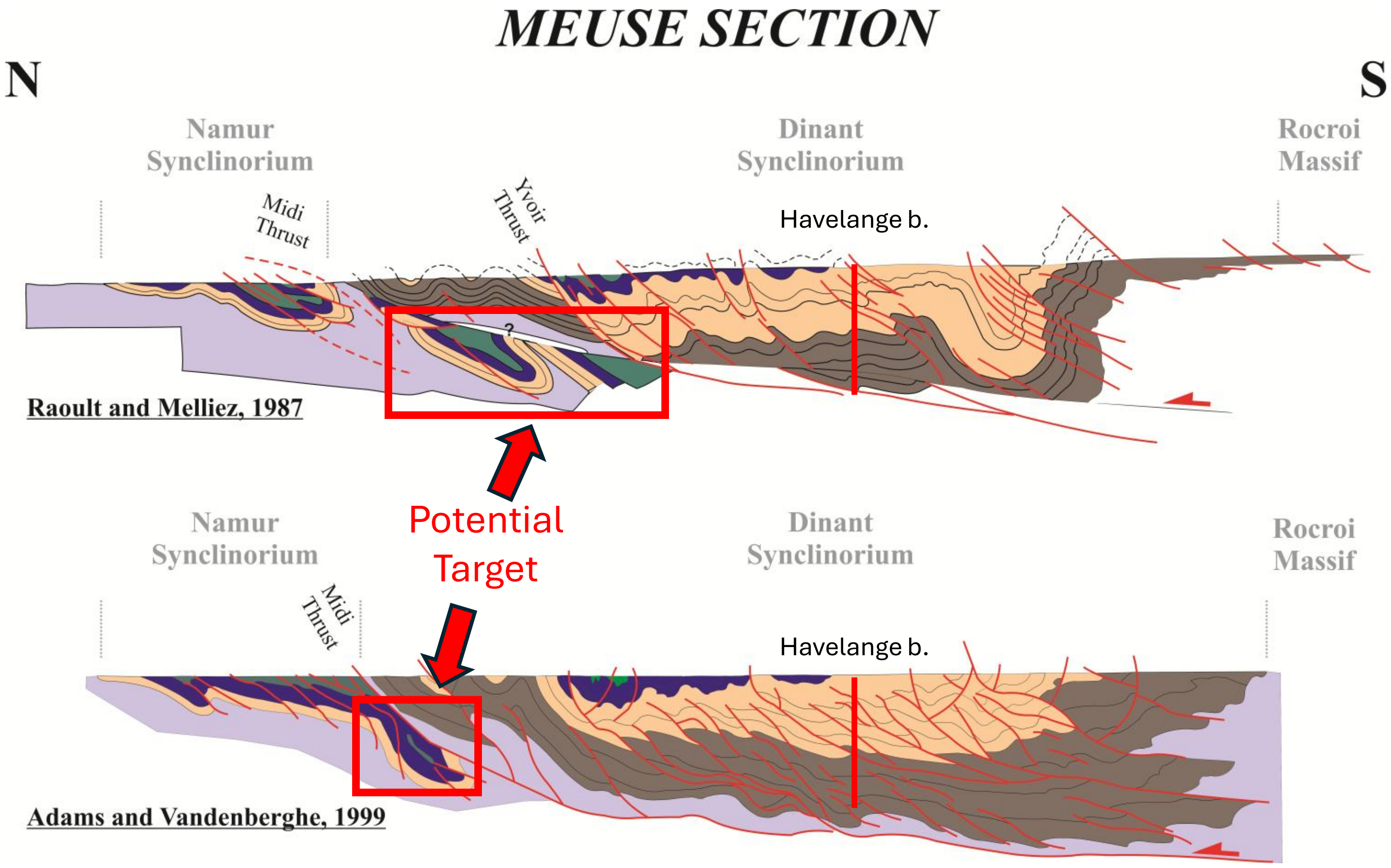
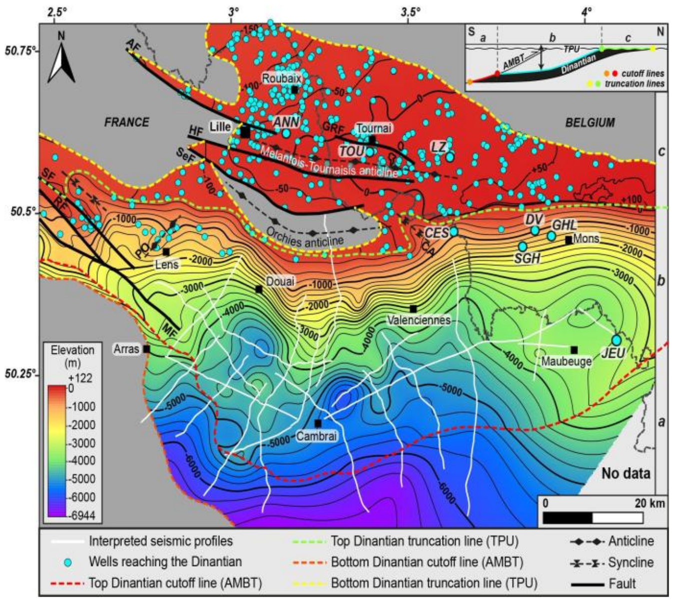
Introduction

- GeoCOND2022 seismic campaign is part of the Interreg NWE project **DGE-ROLLOUT** aiming to support the development of deep geothermal in North-West Europe
- In BE, DE, NL & FR regions, a specific focus was given to the cartography of potential geothermal reservoirs in **deep Dinantian** limestones
- In Wallonia, the scientific question of the southward extension of these limestones under the Midi Thrust Fault was raised following contradictory models**. Which one to use?**
- One of GeoCOND2022 seismic line (L1) crossed the Havelange borehole. This deep borehole (5648 m MD) was restudied in the framework of the **H2020 MEET project**

Geological Setting

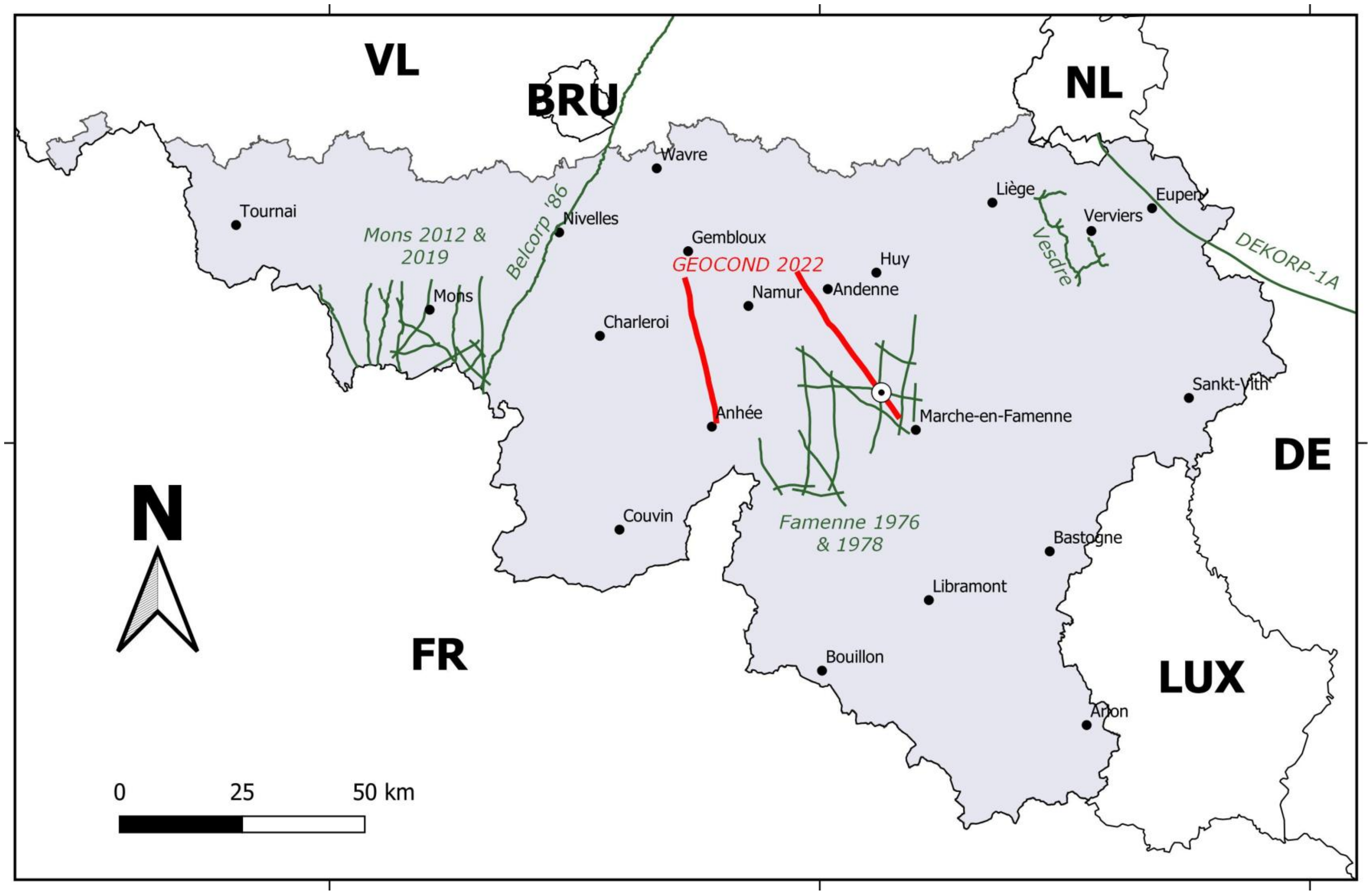
- Silesian
- Dinantian
- M & U Devonian
- Lower Devonian
- Lower Paleozoic





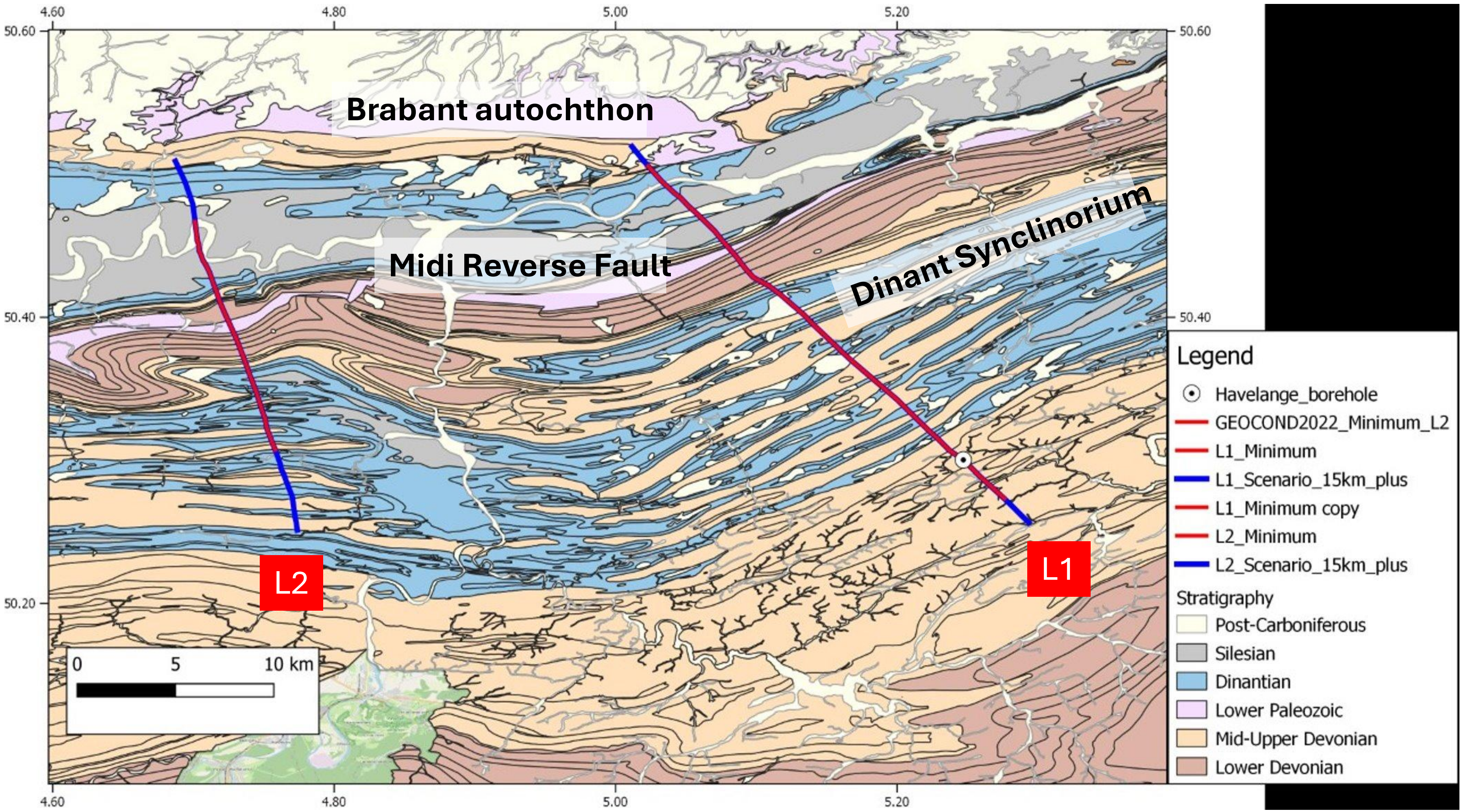
From A. Laurent et al. 2021

Location of seismic lines in Wallonia and cross-borders

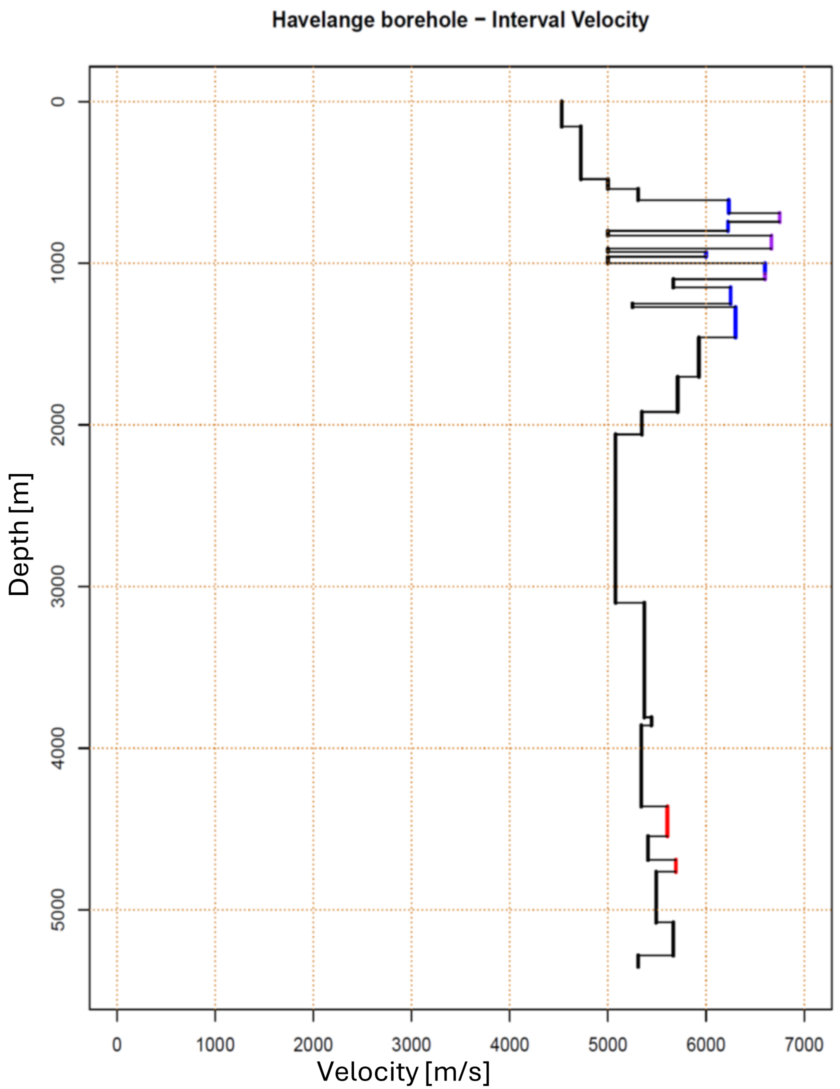


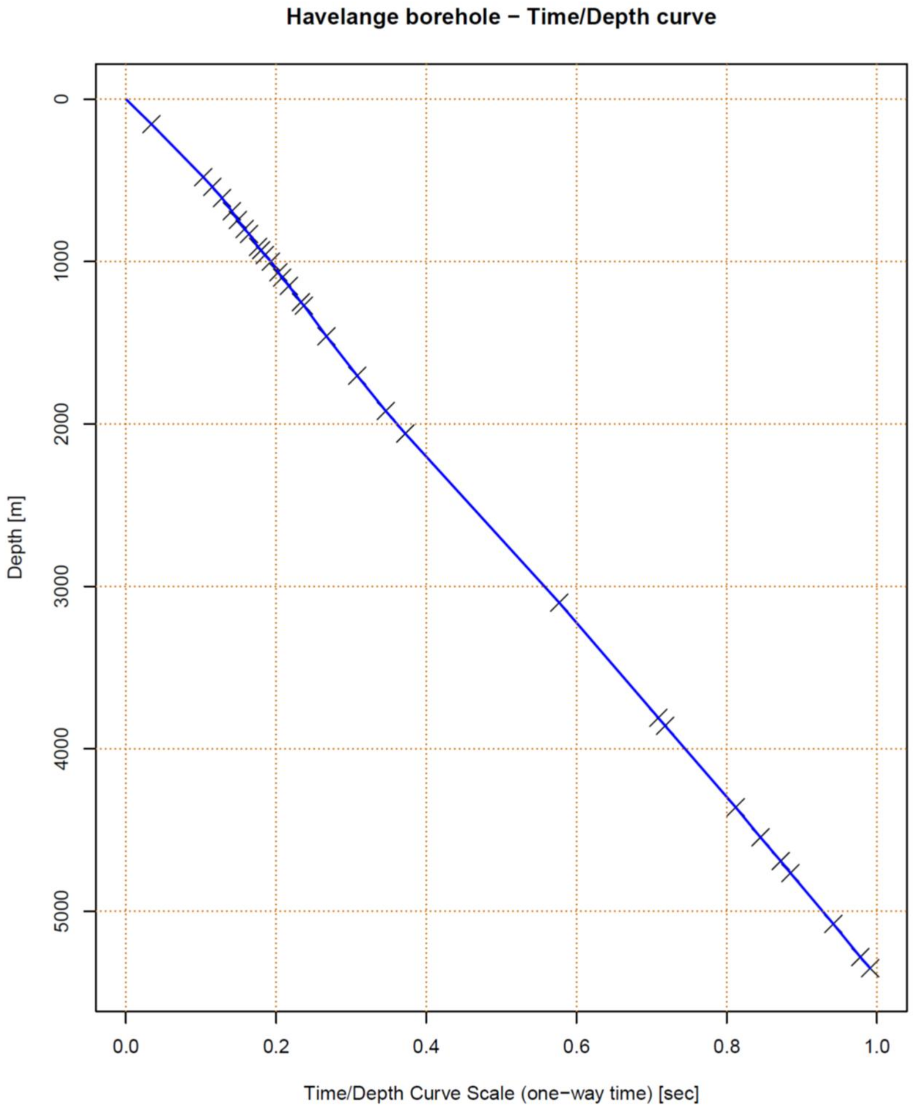
Traces

Traces of GeoCOND2022 seismic lines on Geological map



Havelange borehole sonic data and Time/Depth curve





Legend
Purple = dolostone
Blue = limestone
Red = quartzite
Black = other

GeoCOND2022 campaign organization

Permitting

Permitting was conducted by our colleagues for **UMons**
From September until December 2022
1000+ land plots identified (field, forest, ...) contact with the owners and/or tenants
Research for utility infrastructure

Vibrations

Peak Particle Velocity (PPV) monitoring
DIN4150 Norm
- Commercial buildings: Vrms < 25 mm/s @15Hz
- Recent houses: Vrms < 8 mm/s @15Hz
- Sensitive buildings: Vrms < 4 mm/s @15Hz

Support companies

GTG: geophysical company
RTS: record processing
EPI: QC equipment and work conducted by GTG
Team Lewis: communication (authorities, citizens, media)

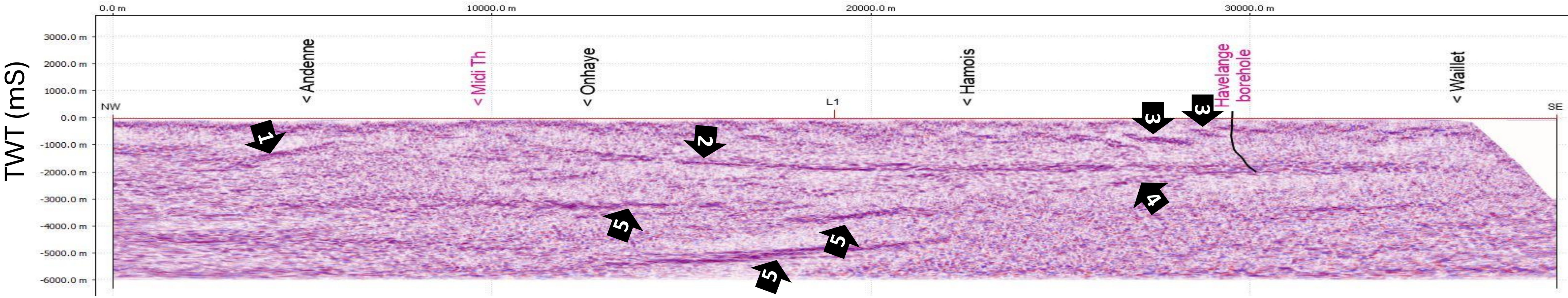
Acquisition conditions and parameters

Three vibrators Ivy Mark 4 (44 000 lbs)
Vibrator electronics: SERCEL VE464
Acquisition: from 14/12/2022 until 01/01/2023
Sweep:from 4 (or 8Hz) to 90Hz (linear)
Sweep time 1 or 2X during 20 sec
Listening time: 6 sec
Receiver spacing: 10 m
Vibrator step: 20 m

Receivers

STRYDE node accelerometer
Frequency flat response between 1-125 Hz
Sensityivity: 3.6 V/g
Acquisition rate: 2 ms (continuous)
Autonomy: 2 – 4 weeks
Weighs: 150 g
Size: 129X41 mm
L1: 3008 STRYDE deployed
L2: 2935 STRYDE deployed

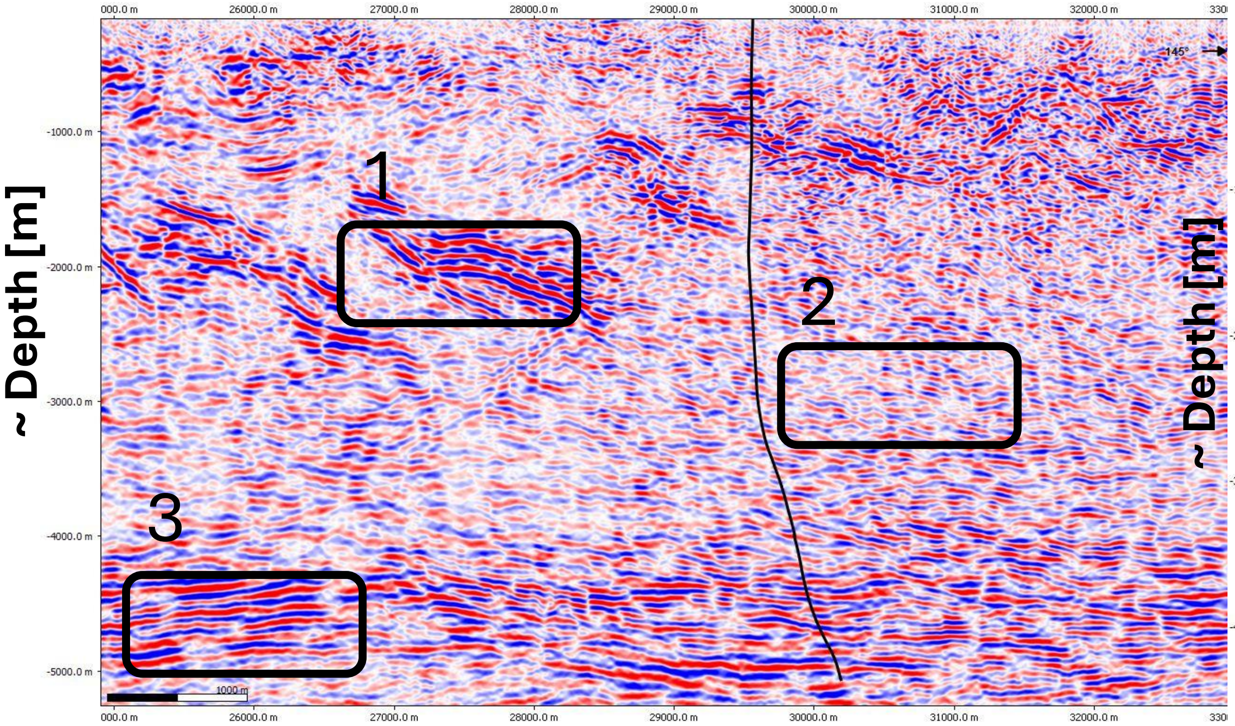
GeoCOND2022-L1: Key reflectors



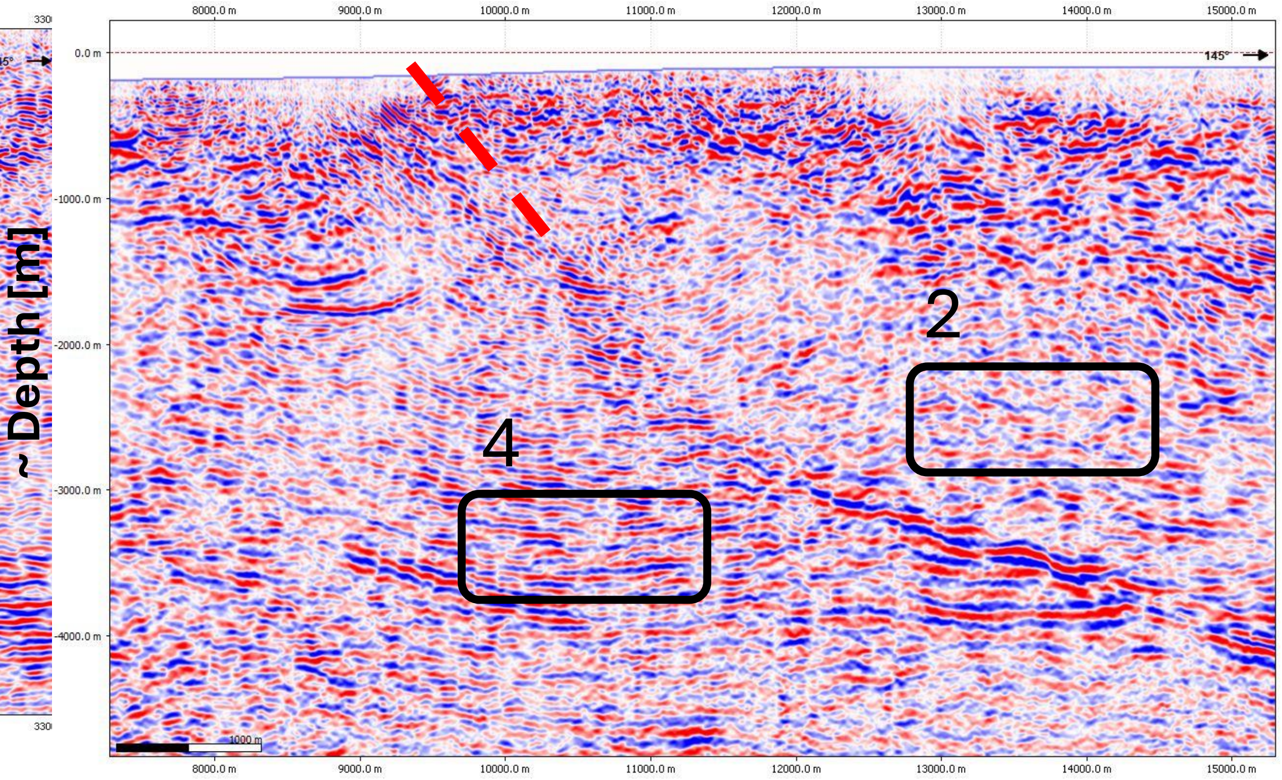
Number	Reflector characteristics
1	N-dipping reflector near Andenne between 840 and 1660 ms (TWT)
2	Flat strong reflector at depth (1815 ms). Intersected by the Havelange borehole. Shallowing N-ward. Fitting with the outcrop of the Midi Thrust.
3	Shallow strong reflectors interpreted as imbrication of Givetian-Frasnian limestone horses
4	Weaker N-dipping reflector in angular unconformity with reflector of Midi Thrust
5	Deep reflectors (>3000 ms) organized as an open synform

GeoCOND2022-L1: seismic reflection « facies »

Southern part of the profile



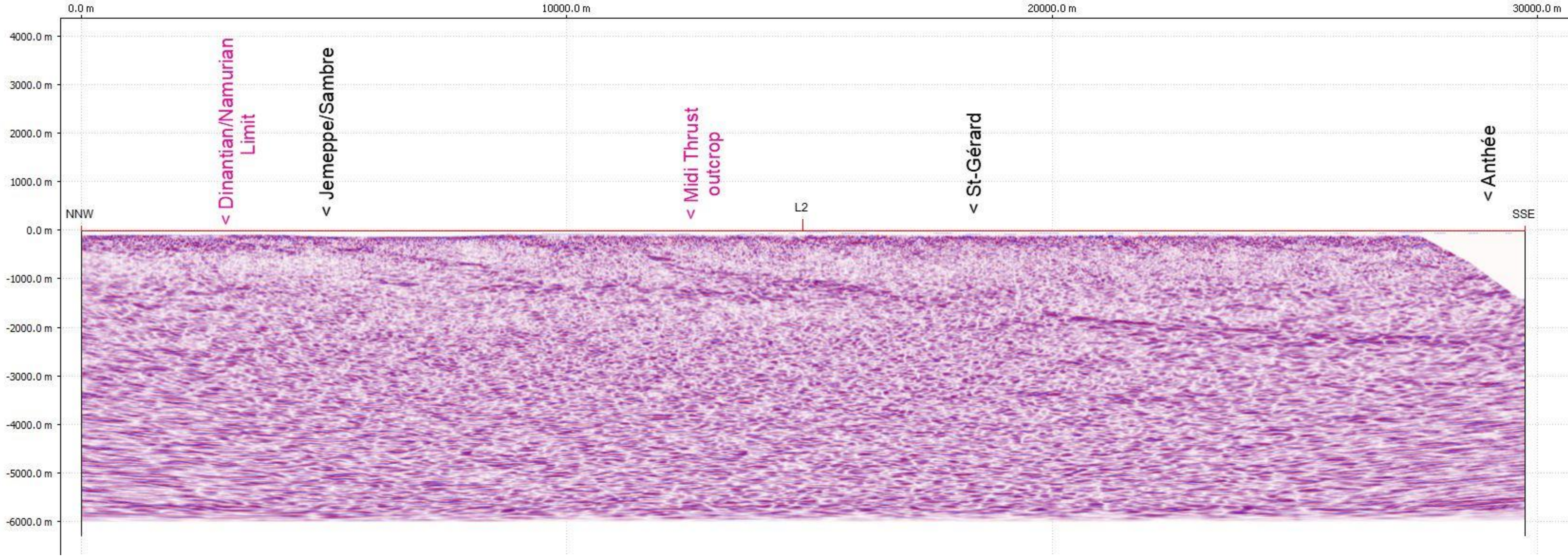
Northern part of the profile



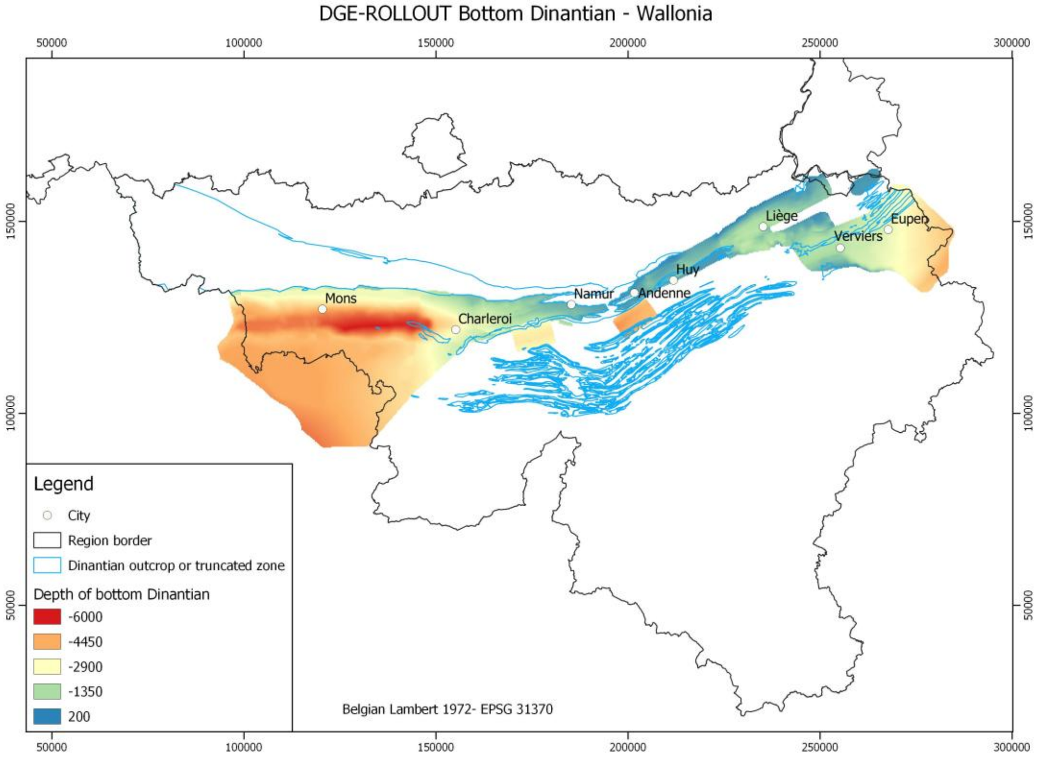
Facies 1: Givetian-Frasnian horses separated by shale
Facies 2: Lower Devonian + Eifelian formations
Facies 3: Midi Thrust reflector (basal erosion or 3D effect?)

Facies 2: Lower Devonian + Eifelian formations
Facies 4: Dinantian Limestone

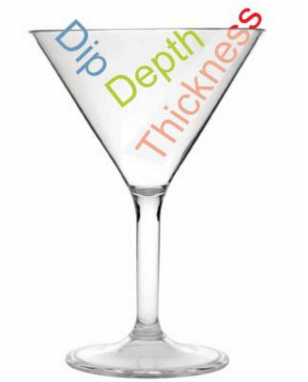
GeoCOND2022-L2

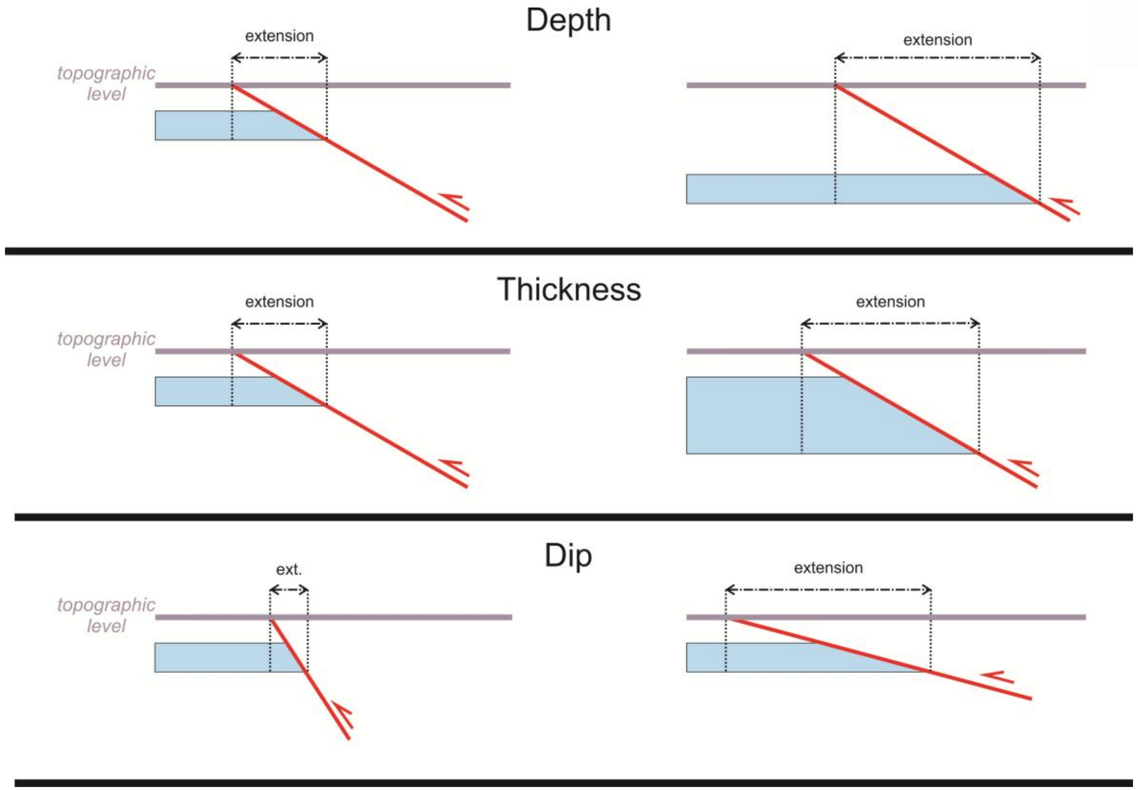


Why such lateral difference?



It's a geometrical cocktail





Conclusions

- GeoCOND2022 campaign provides new insights for the assessment of potential Dinantian limestone geothermal reservoirs under the Midi Thrust fault in central Wallonia
- From line L1, the Midi Thrust follows a trajectory steep dip near the surface to become flat at a depth of c. 5000 m. This fault zone appears as a strong and thick reflector (3D effect or basal erosion)
- The detachment zone (flat part of Midi Fault) is probably close to unconformity between the Lower Devonian rocks and its basement
- Better characterization of the Givetian-Frasnian limestone imbrication in the Dinant Synclinorium
- The southward extension of Dinantian limestone in central Wallonia seems restricted
- Deep reflectors were identify in the basement and are organized as a wide open synform structure intersecting the Midi Thrust as an angular unconformity

Future analyses

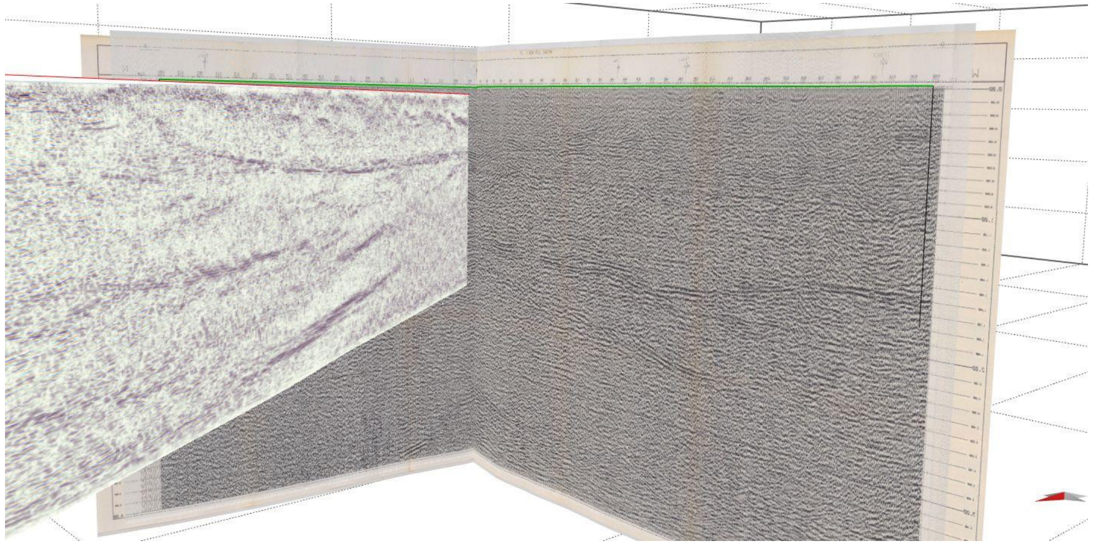
Focus on the data processing of the passive signal recorded during the campaign

Identification/attribution of the deep reflectors below the Midi Thrust fault

Identify the reasons of signal quality difference between lines L1 and L2

Improve the quality of seismic facies characterization

Integrate GeoCOND2022-L1 profile with the lines of Famenne78 campaign



Perspectives

WalScan
Exploration du sous-sol wallon pour la géothermie profonde