# How deep is geothermal energy in Wallonia?

*Geoconnect³d Webinar*
*24th of June 2020*

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Avec le soutien de la Wallonie

# PLAN

1. Introduction
2. What are the deep geological infos of Wallonia?
3. What are the Walloon areas of geothermal interest?
4. Is the geothermal resource proven?
5. What are  the current and future underground investigations to improve DGE implementation in Wallonia?
6. Conlusions

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# 1. Introduction: The Geological Survey of Belgium implication in geothermics

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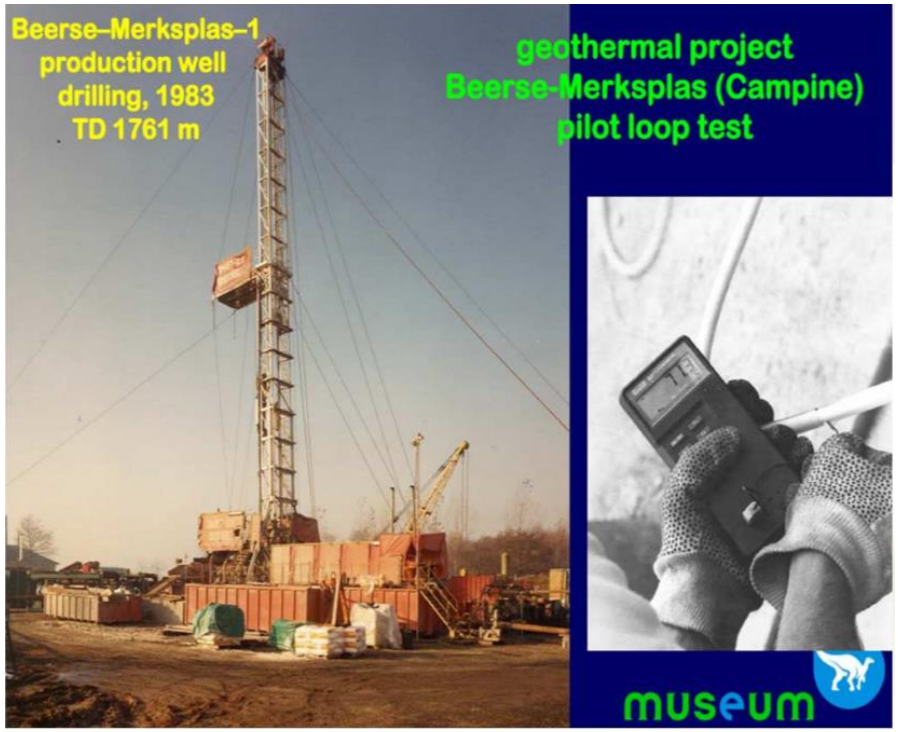
- Start in 1952-55 with the Turnhout geothermal well drilling (2706 m, 102°C at 2155 m)
- Geothermal wells in the 70's/ 80's : Saint-Ghislain, Douvrain, Ghlin, Meer, Beerse Merksplas (gas show), Chaudfontaine, 's Gravenvoeren
- Involvement in R&D in shallow and deep geothermal energy (SGE-DGE) through regional, national and EU projects since 2009 focusing on
  - geothermal exploration
  - geothermal resource assessment and mapping
  - geo-economic modelling…




GEO CONNECT³d

BRUGEO
geothermie.brussels

Interreg
EUROPEAN UNION
North-West Europe
DGE-ROLLOUT

MUSE GeoERA
Managing Urban Shallow Geothermal Energy
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731166

DESIGNATE
Decision Support under Uncertainty for Geothermal Applications

MEET
Multi-sites EGS Demonstration

GEOCAMB

ESTMAP
Energy Storage Mapping and Planning

ALPI
Assessment of Low carbon society Policy Instruments
ALPI Policy Instruments for a low carbon society

GEOELEC

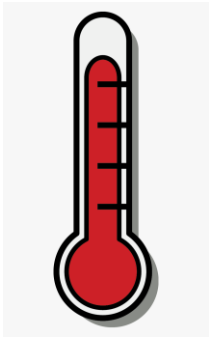
ThermoMap

GEO FJ POWER

GEOTRAINET
Geo-Education for a sustainable geothermal heating and cooling market

# 1. Introduction: the 3 ingredients for Geothermal Energy

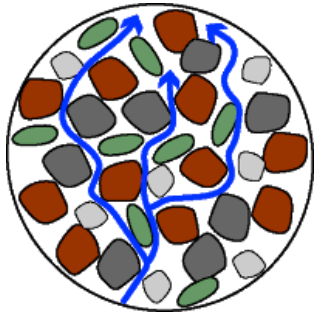
Only 3 (apparently simple) ingredients are necessary for DGE:



**1. Heat** which is naturally stored everywhere in the subsurface, depends on local geothermal gradient

**2. Fluid** which act as a carrier to extract heat from the reservoir and flow towards the surface. The geothermal fluid can be:

- In the liquid phase
- In the steam phase
- A mixture of the two

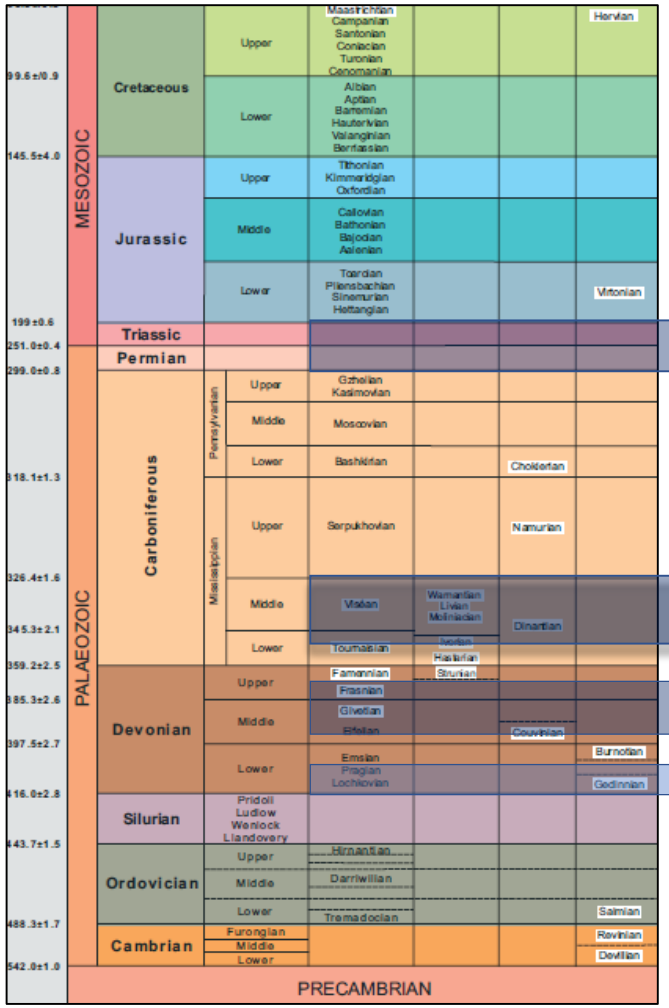


**3. Permeability** which is the property that allows the fluid to flow across the reservoir and eventually to be produced

# 2. What are the deep geological infos of Wallonia?

## Deep buried potential aquifers and rock target for DGE (potentially enough permeable…)

### Stratigraphic chart of Belgium




Sandstone, conglomerate (Permian and Upper Trias)

Upper Tournaisian and Visean limestones (Dinantian)

Eifelian, Givetian, Frasnian limestones

Lower Devonian sandstone and quartzite (EGS)

Interreg North-West Europe DGE-ROLLOUT

MEET Multi-sites EGS Demonstration

# 2. What are the deep geological infos of Wallonia?

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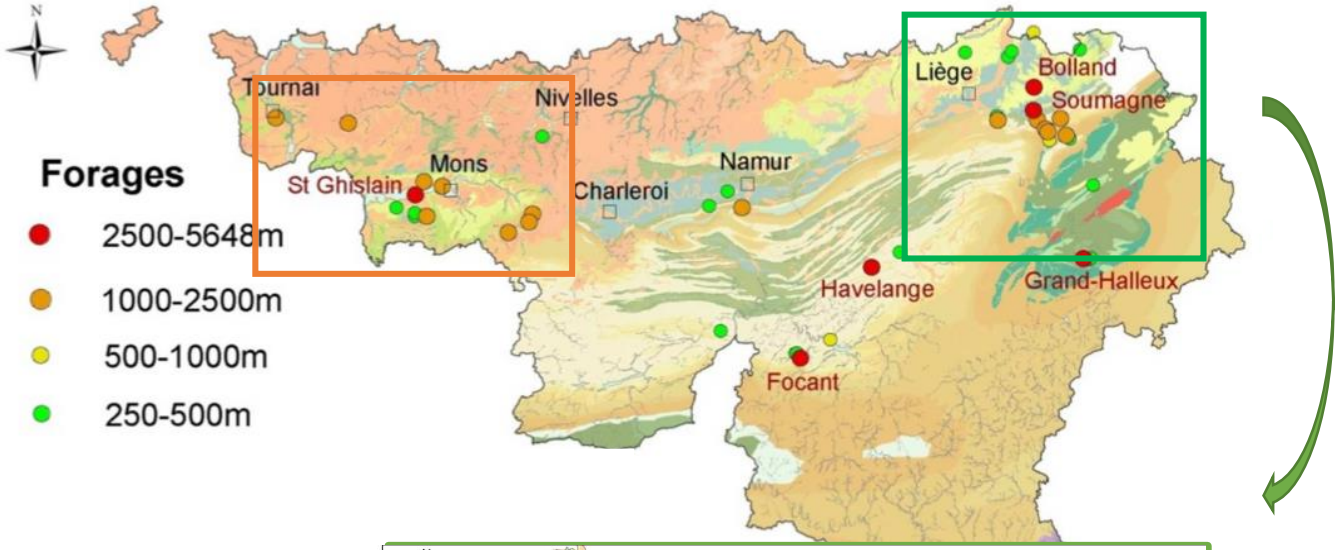
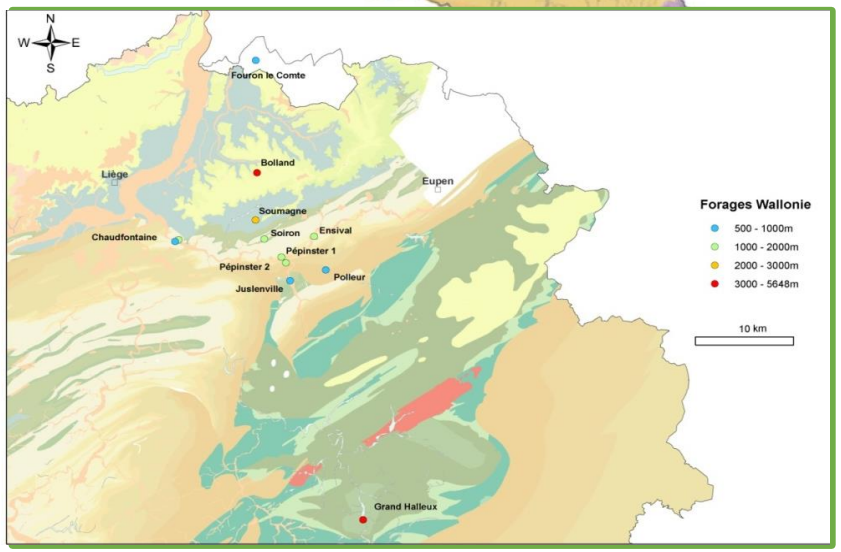
## Deep Boreholes of Wallonia (22 with temperature data)



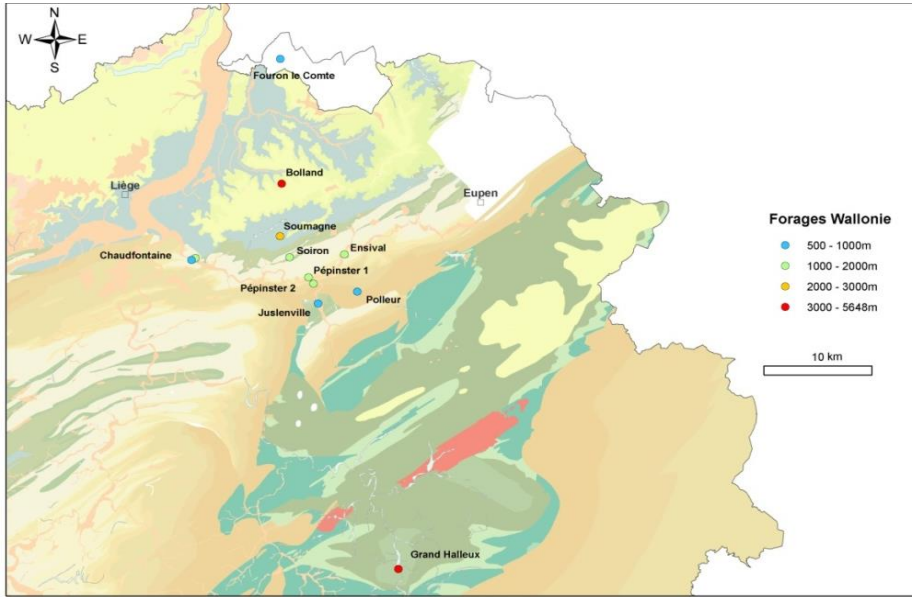



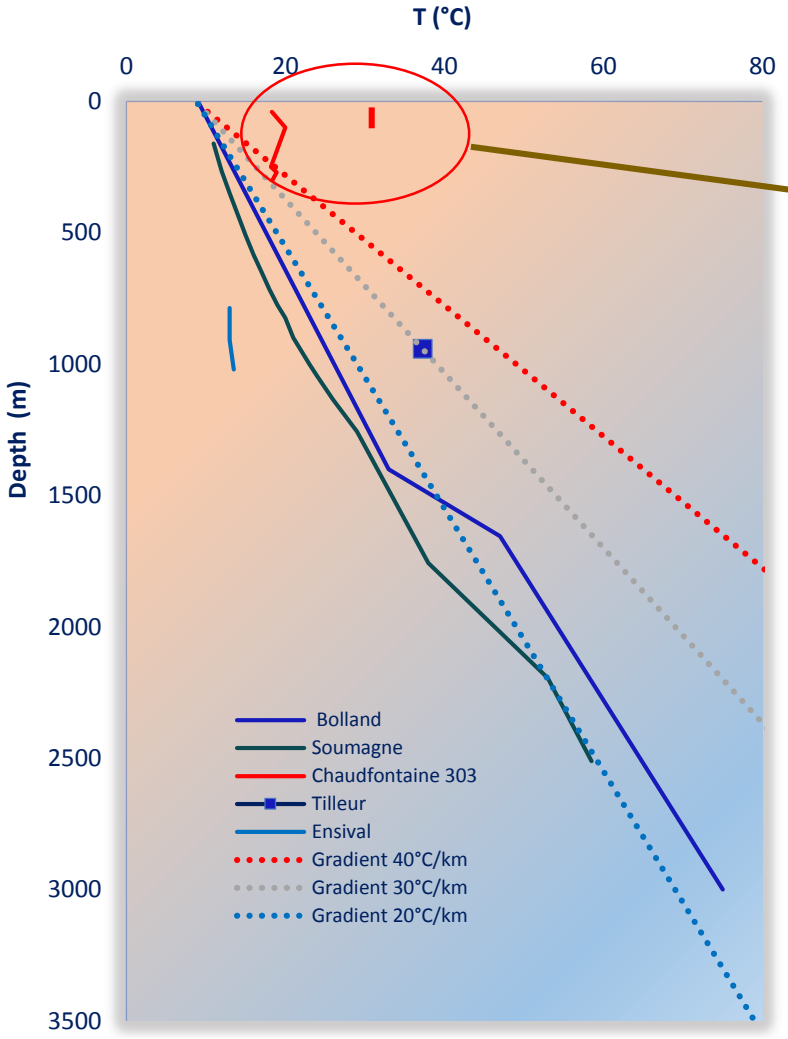

| | Drilling | Depth (m) | Geothermal Gradient (°C / km) |
|---|---|---|---|
| Hainaut Charleroi Tournai | Saint-Ghislain | 5403.0 | 32.30 |
| | Jeumont (France) | 4338.0 | 20.44 |
| | Epinois | 2009.0 | 23.50 |
| | Paturages | 2000.0 | 29.70 |
| | Fontaine l'Evêque | 1900.0 | 23.69 |
| | Ghlin | 1579.0 | 38.60 |
| | Douvrain | 1447.3 | 42.70 |
| | Vieux-Leuze | 1536.0 | 24.66 |
| | Rieu du cœur | 1342.0 | 31.64 |
| | Quévy | 1275.0 | 29.58 |
| | Tournai | 1271.0 | 29.75 |
| | Marcinelle | 1254.0 | 19.92 |
| Liège Herve | Bolland | 3001.3 | 22.00 |
| | Soumagne | 2512 | 19.70 |
| | Chaudfontaine | 1229.0 | 31.33 |
| | Ensival | 1020.4 | 4.71 |
| | Tilleur | 942.0 | 29.51 |
| | Fouron le Comte | 866.0 | 31.82 |
| Ardenne | Havelange | 5648.0 | 20.30 |
| | Grand-Halleux | 3225.5 | 19.22 |
| | Focant (S27) | 3208.0 | 26.10 |
| | Wépion | 2310.0 | 22.17 |

# 2. What are the deep geological infos of Wallonia?

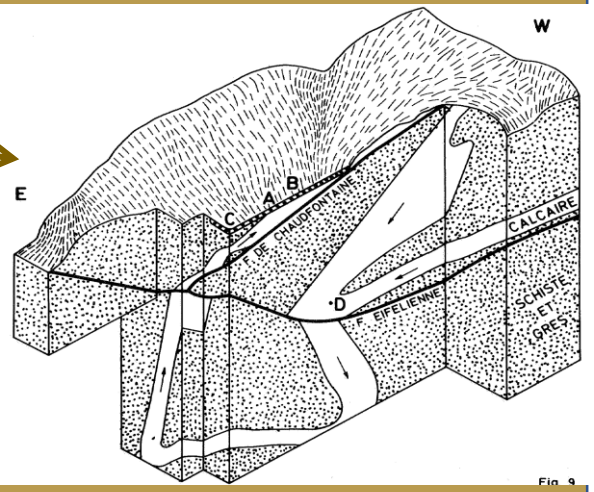
## Geothermal gradient variability in Belgium

### The strong influence of groundwater circulation (e.g. eastern Liege area)




Chaudfontaine "hot" anomaly




*Graulich, 1983*

The temperature measurements variability could be explained by lithology changes, meteorological water infiltration, and **by deep hydrothermal circulation (faults, karstic areas).**

# 2. What are the deep geological infos of Wallonia?

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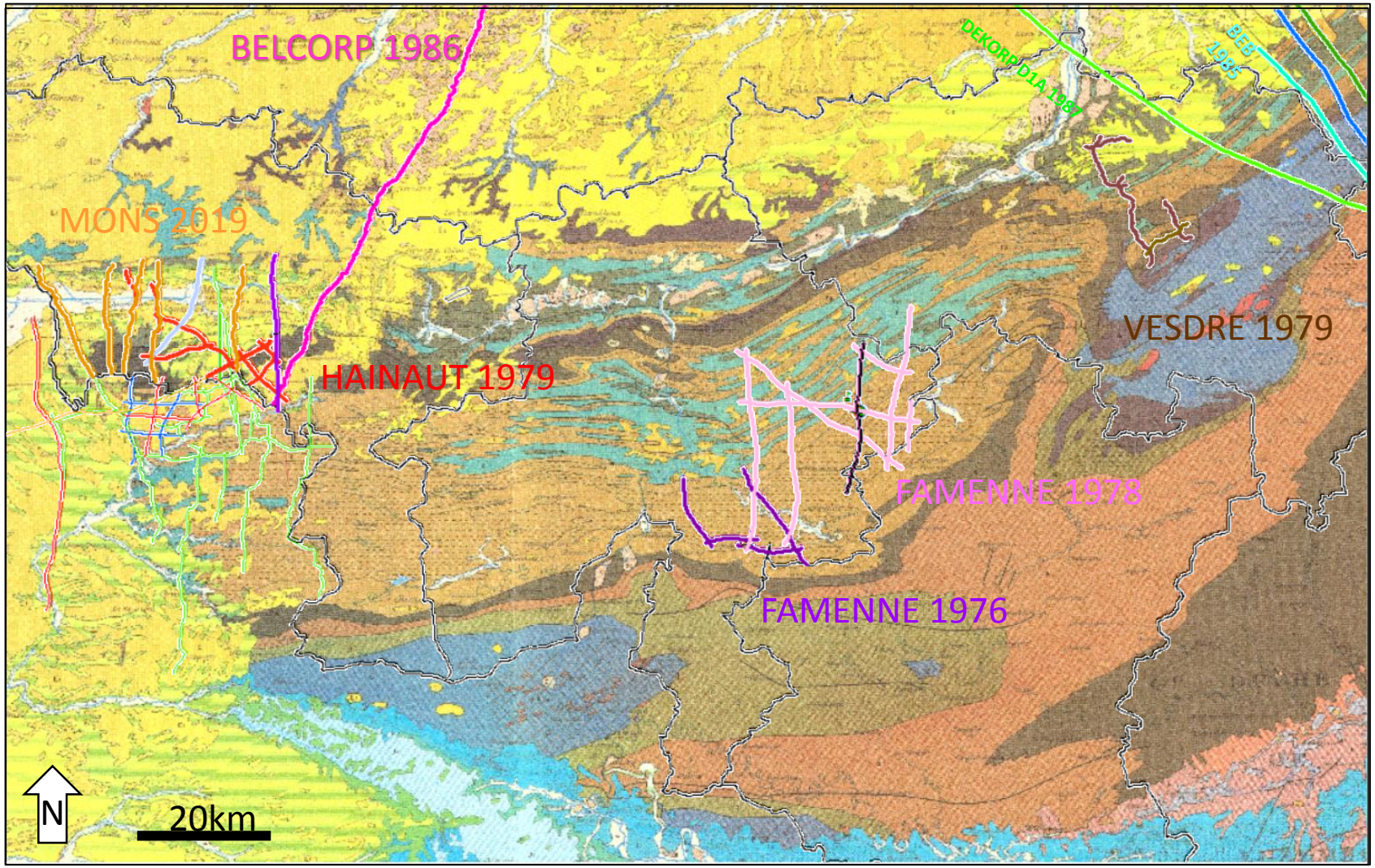
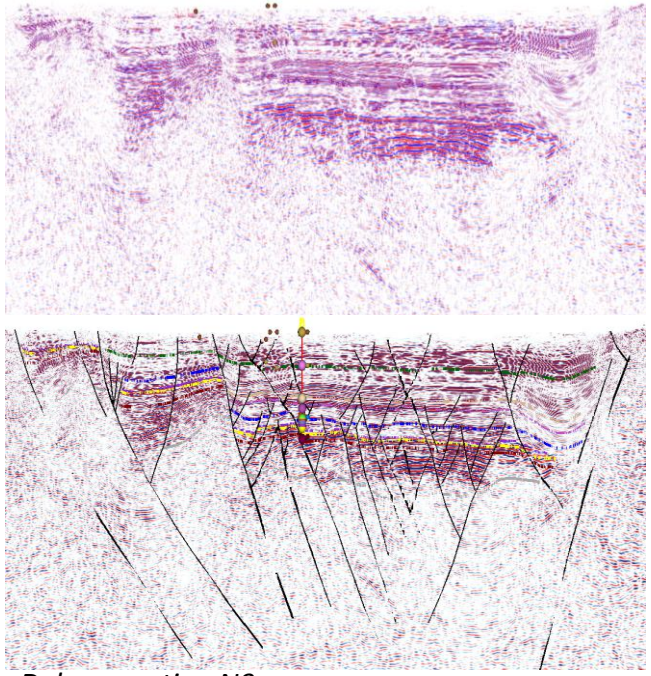
## How to understand and visualize deep underground structures?




*Vibroseis truck*

## Undirect geophysical methods: seismic reflection



*Dekorp section N9*

# 2. What are the deep geological infos of Wallonia?

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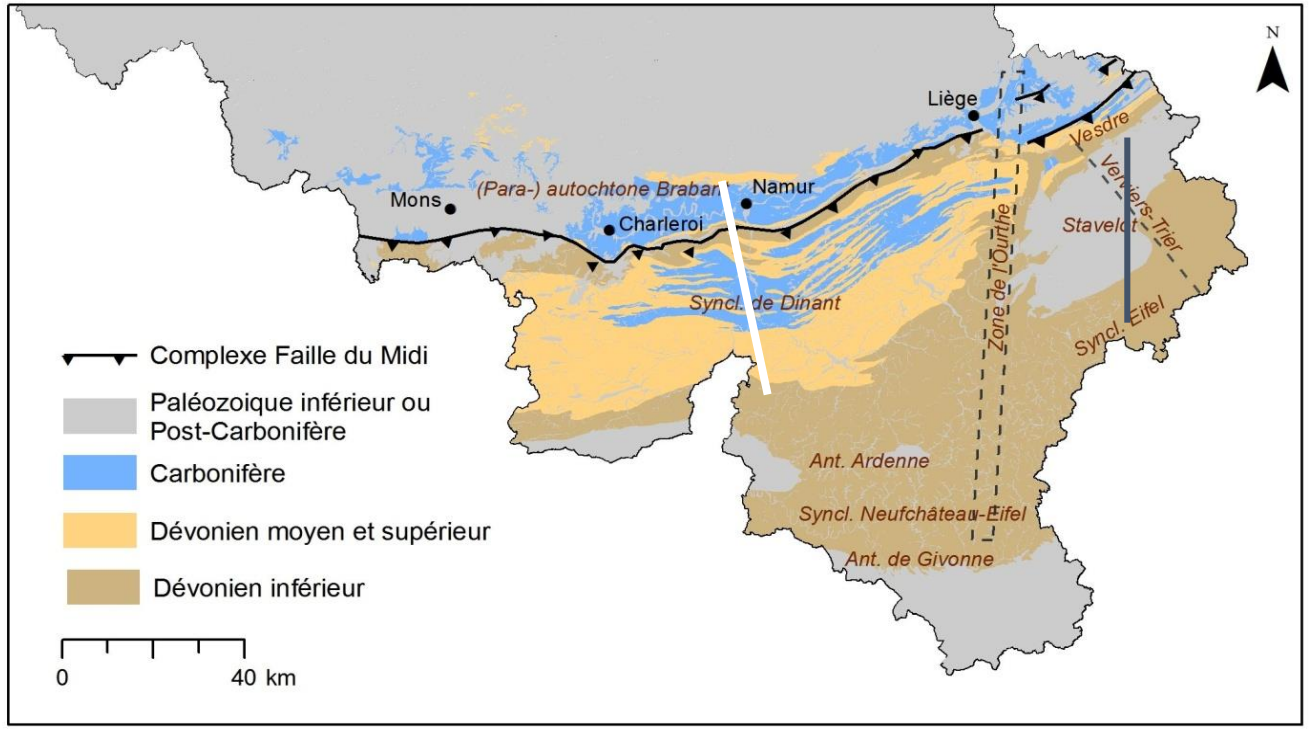
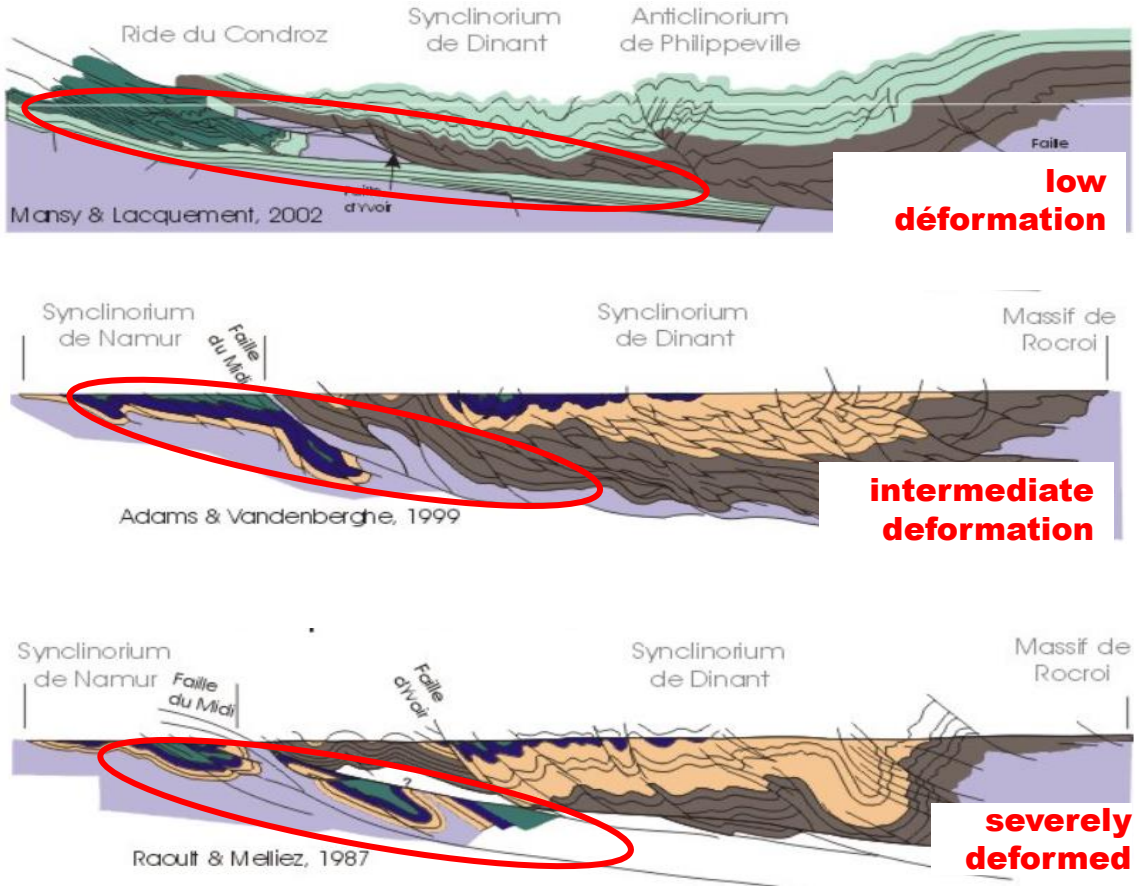
## Location map of Devono-Carboniferous outcrops in Wallonia and major structural units

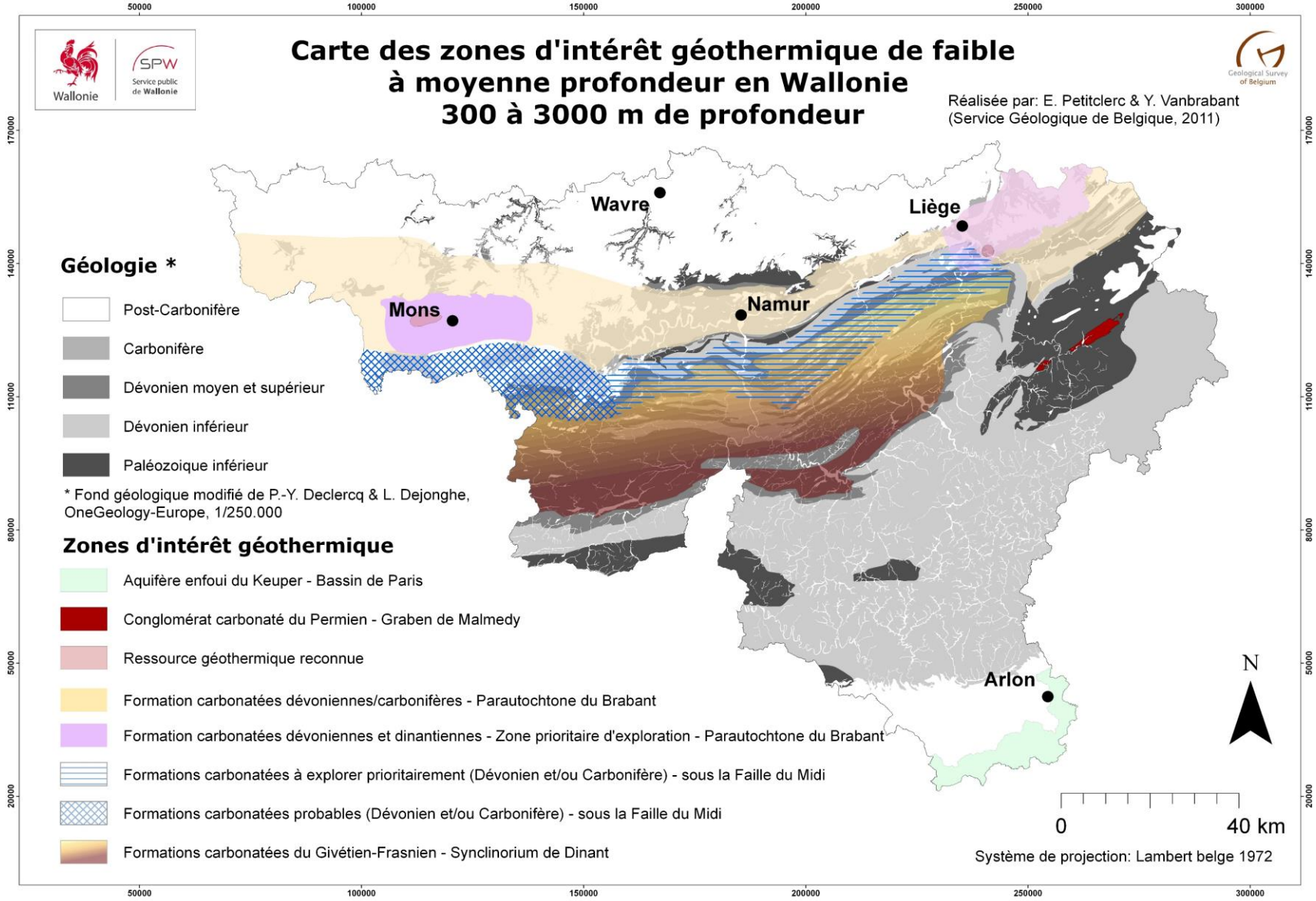



**=> Numerous divergeant interpretations to explain the data**

## Example of 3 geological cross-sections across Ardenne Massif



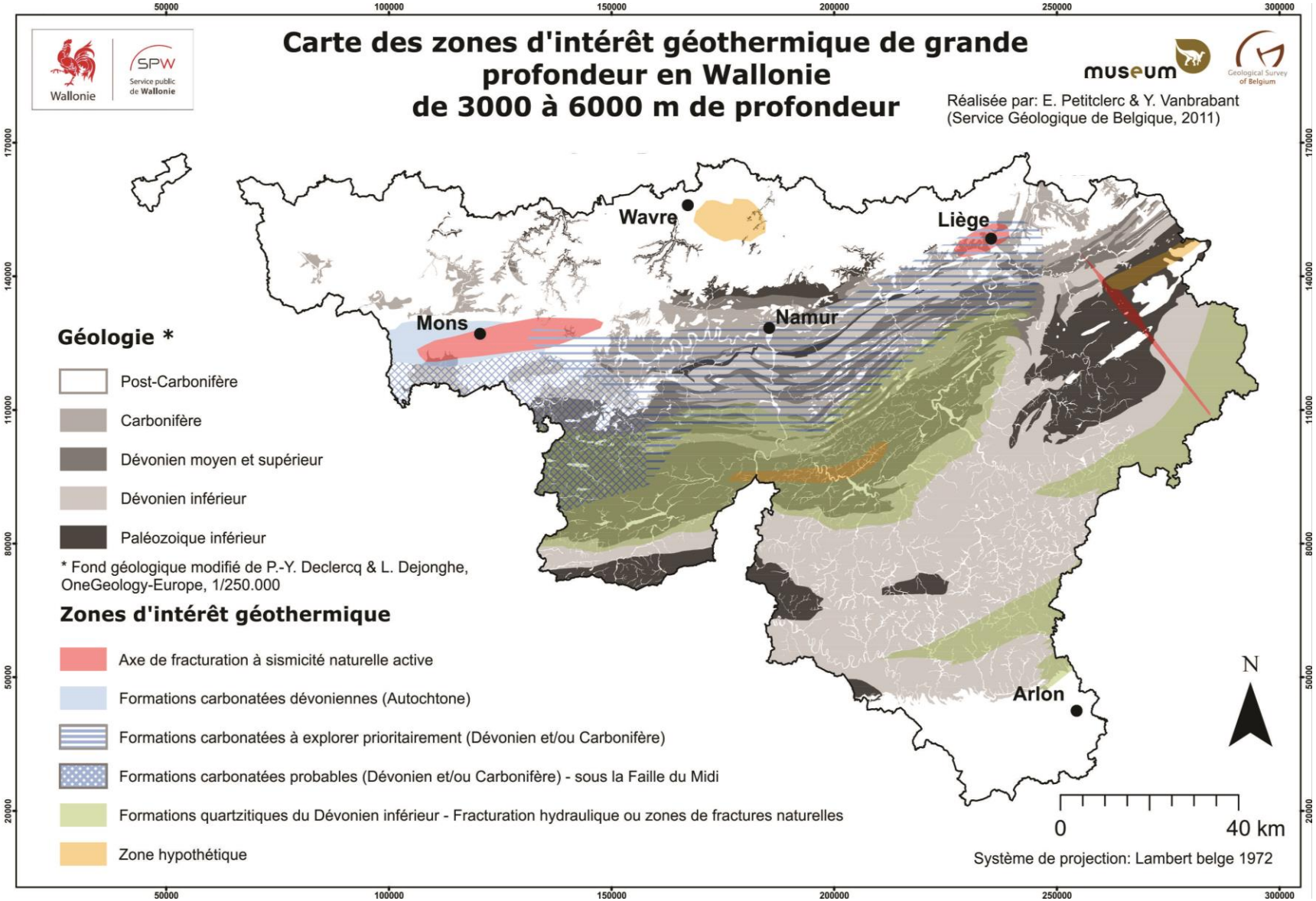
# 3. What are the Walloon Geothermal Zones of interest?




**Zones of geothermal interest**: areas where the most promising geological units could be found at a sufficient depth and with a sufficient thickness to be investigated for geothermal energy.

- Devonian and Dinantian priority exploration areas
- Devonian and/or Dinantian below the Midi Fault to explore in priority
- Devonian and Dinantian in the Brabant parautocthone
- Devonian and/or Dinantian possible below the midi fault
- Devonian (Givetian and Frasnian) possible in the Dinant syncline

# 3. What are the Walloon Geothermal Zones of interest?




**Zones of geothermal interest**: areas where the most promising geological units could be found at a sufficient depth and with a sufficient thickness to be investigated for geothermal energy.

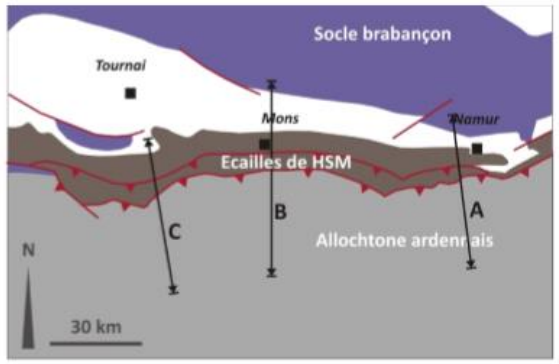
Devonian and/or Dinantian below the Midi Fault to explore in priority

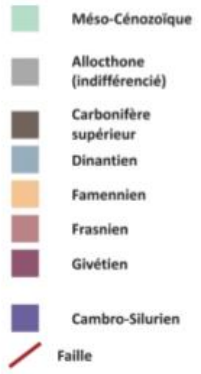
Probable Devonian and/or Dinantian below the Midi Fault

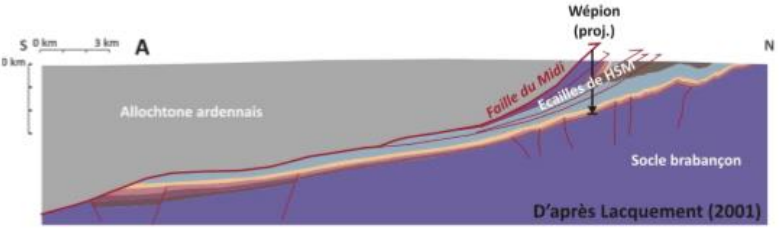
Lower Devonian sandstones and quartzites suitable for EGS?

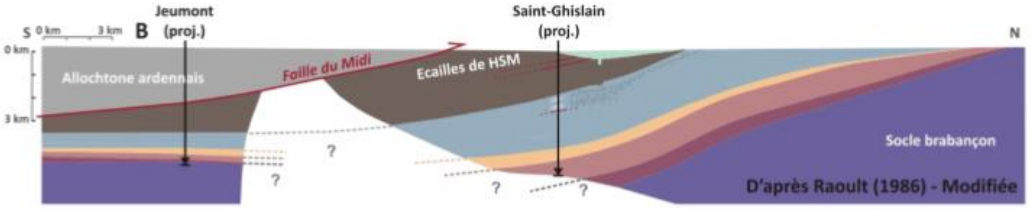
# 4. Is the geothermal resource proven?

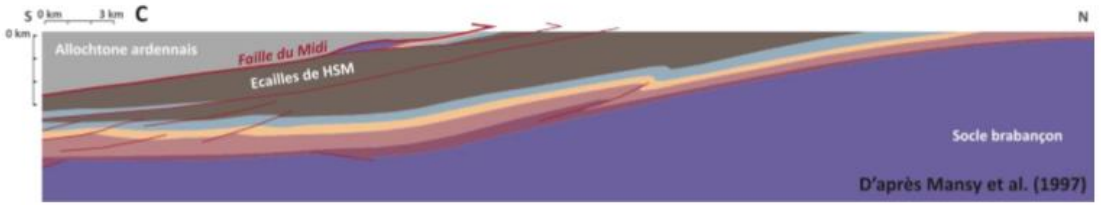
## Three deep artesian geothermal wells in the Mons basin



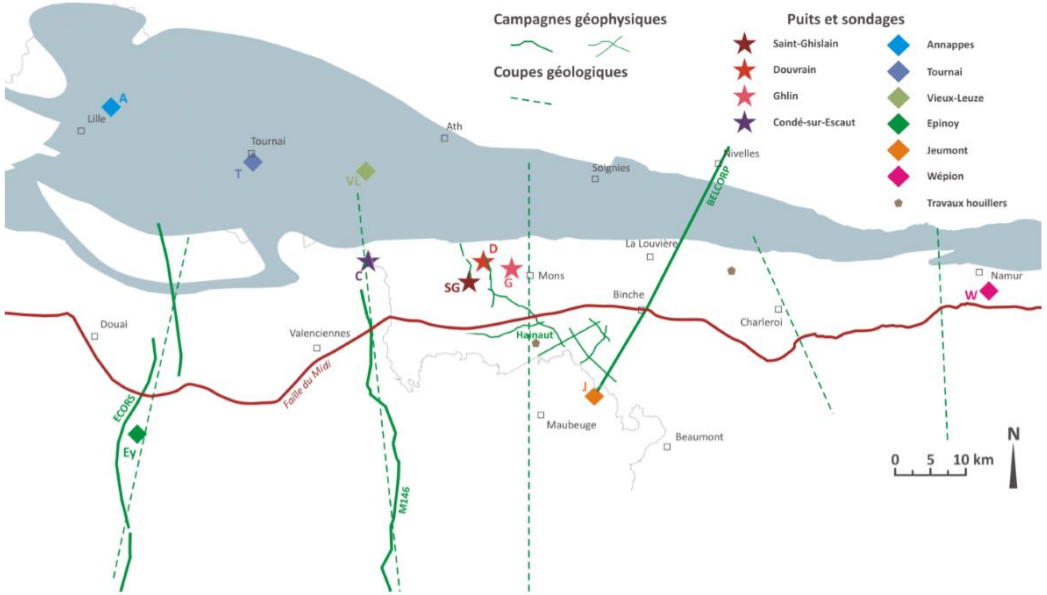




*From Licour (PhD Thesis), 2012*




- **Saint-Ghislain** geothermal District Heating (15MWth) is running since 1986 (T=73°C, Dres=2400m, 100m³/h), and delivers heat towards 1 hospital, 3 schools, 1 swimming pool, 1 train station and 355 housings
- **Ghlin and Douvrain** wells proved the extension of the reservoir of 5km wide (N-S) and 20km long
- Douvrain well covers the needs of the Baudour hospital and the AW EUROPE firm (T=66°C, $D_{res}$= 1447m)

Geothermia, launched in 2018, is the first belgian commercial area (40hect) supplied by Geothermal Heat (7$MW_{th}$ ) by the Ghlin well (T= 71°C, $D_{res}$=1550m, 95m³/h )

New drillings are scheduled in 2021 by IDEA thanks to EU-ERDF investments…

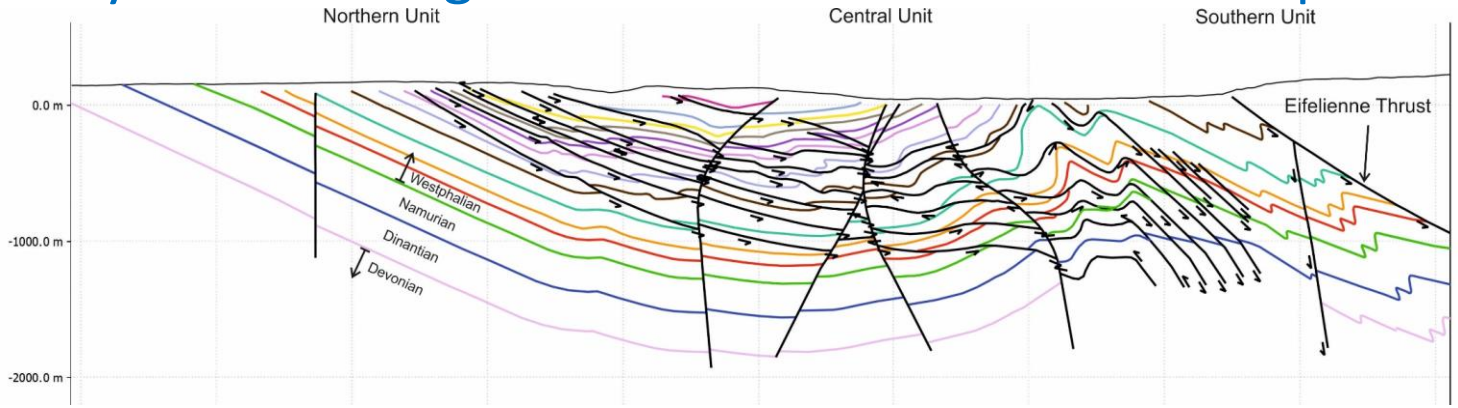
# 5. What are current and future underground investigations to improve DGE implementation in Wallonia?

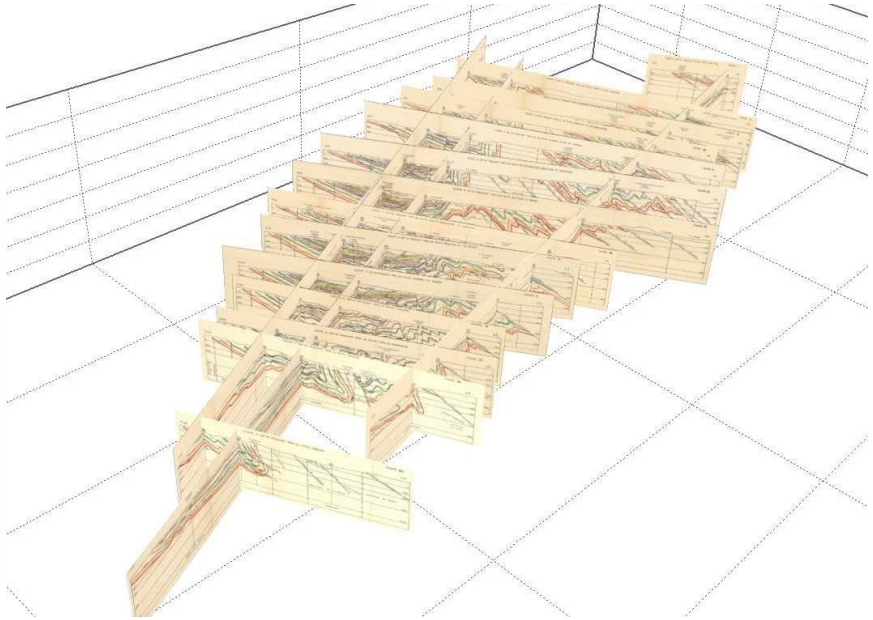
- **DGE-ROLLOUT (Interreg NWE) explores and tests one of the most promising geothermal reservoirs in North-West Europe**
  - **Modelisation of top and thickness of Dinantian limestones**
  - **Deep underground investigations with geophysical surveys.**

- **MEET (H2020) aims at boosting the development of Enhanced Geothermal Systems (EGS) across Europe in various geological contexts (sedimentary, volcanic, metamorphic and crystalline) by different means.**
  - **3D model of Lower Devonian sandstones and quartzites in Havelange area**
  - **Reprocessing previous seismic data**

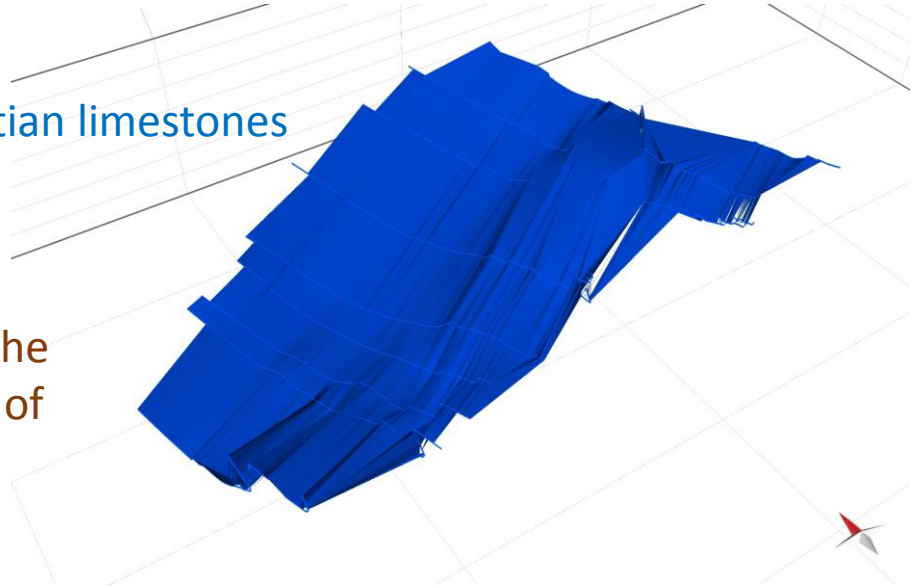
# DGE-ROLLOUT: Modelisation of top and thickness of Dinantian limestones by Yves Vanbrabant

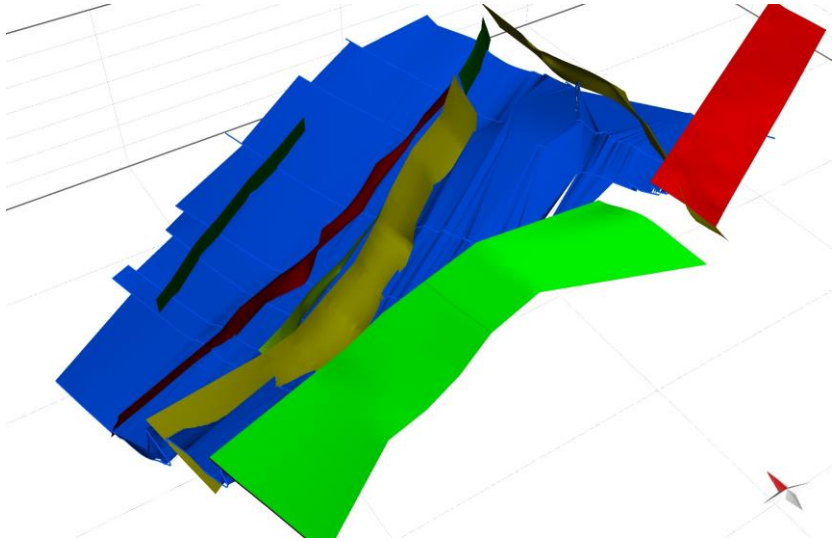
## Geodynamic of Liège Basin based on coal mines maps



Top of Dinantian limestones



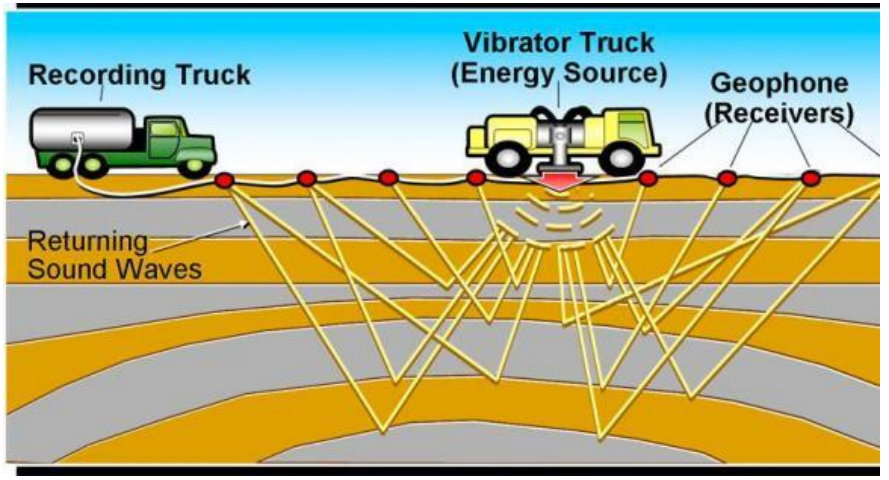


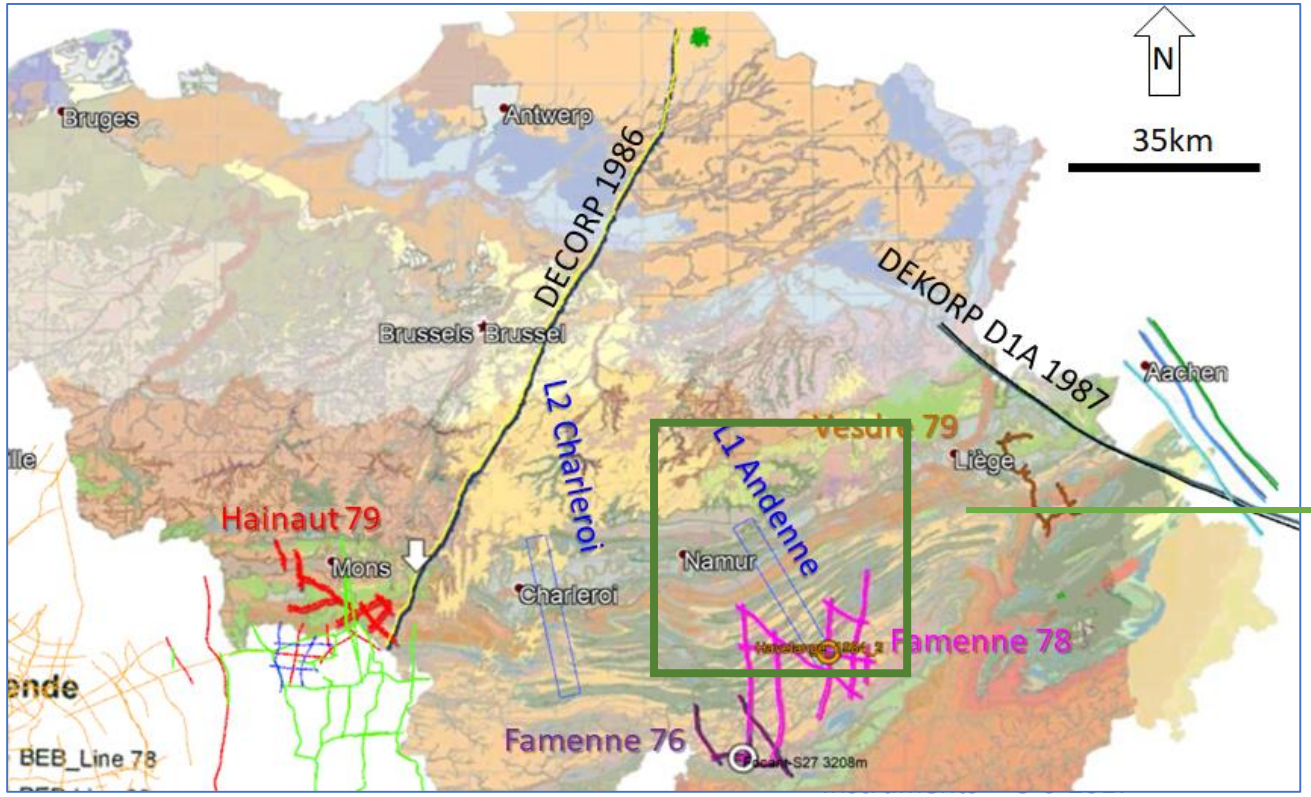
<2000m in the central part of the Liege bassin

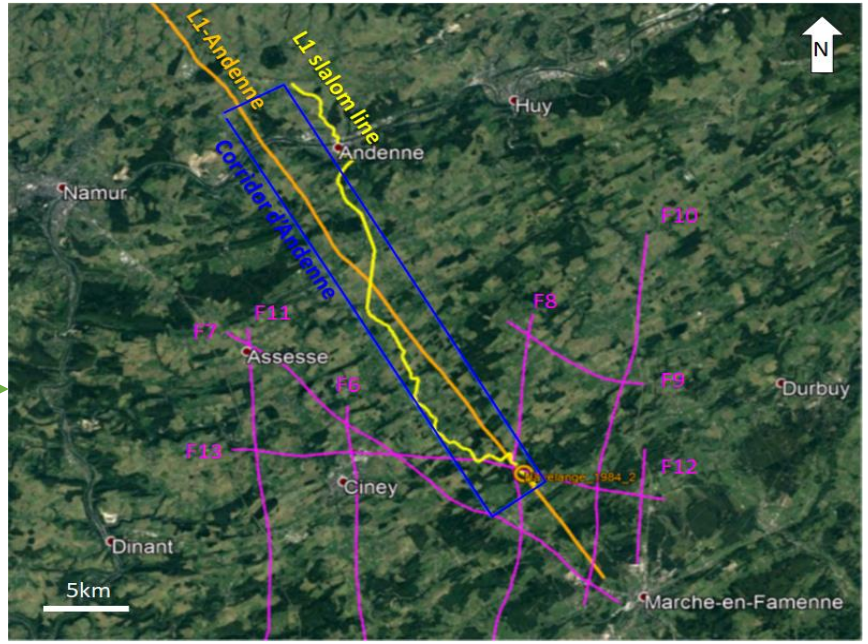
# DGE-ROLLOUT: New Geophysical survey in 2021

2 seismic reflection lines of 30km to recognize the Dinantian reservoir below the Midi Fault (target is 6km depth)

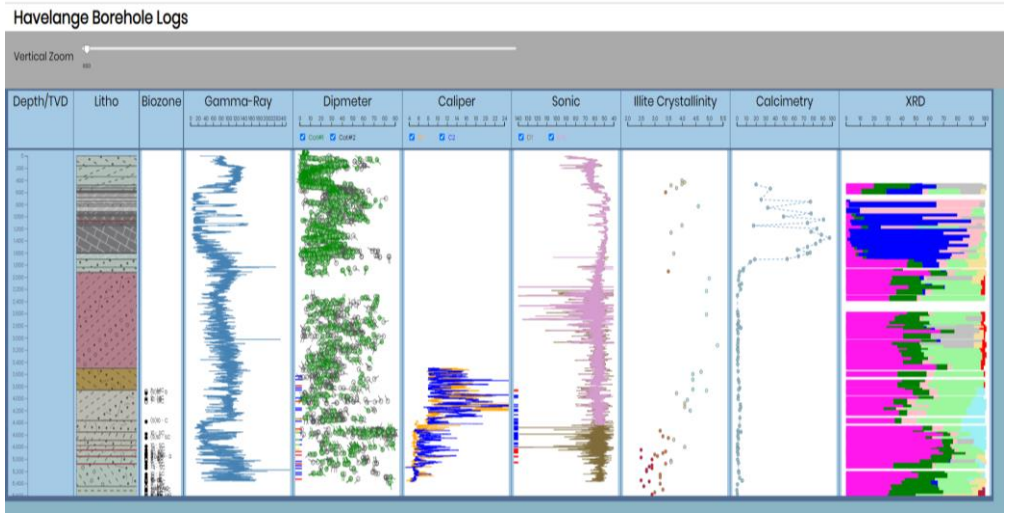
- L1 Andenne West
- L2 Charleroi East



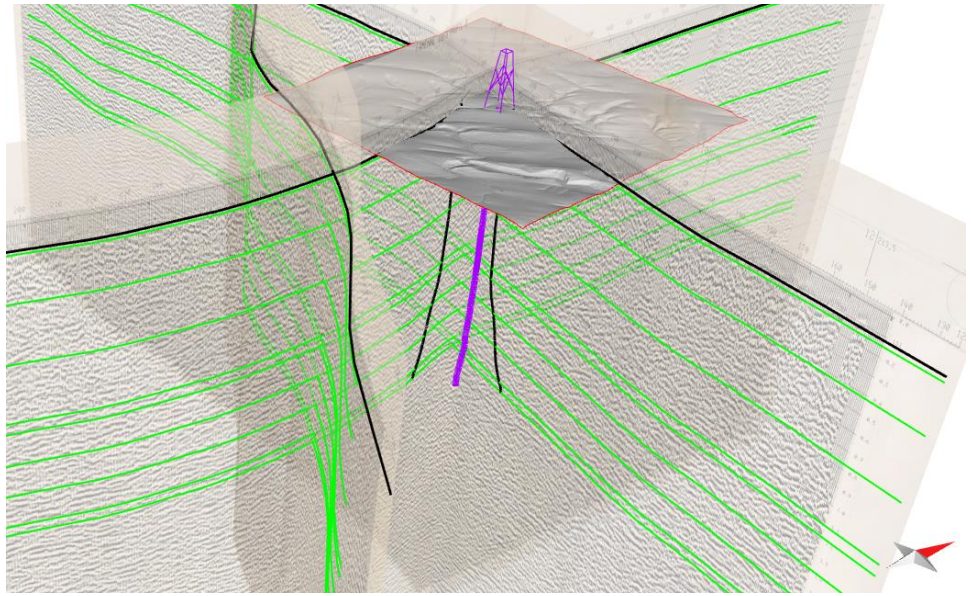



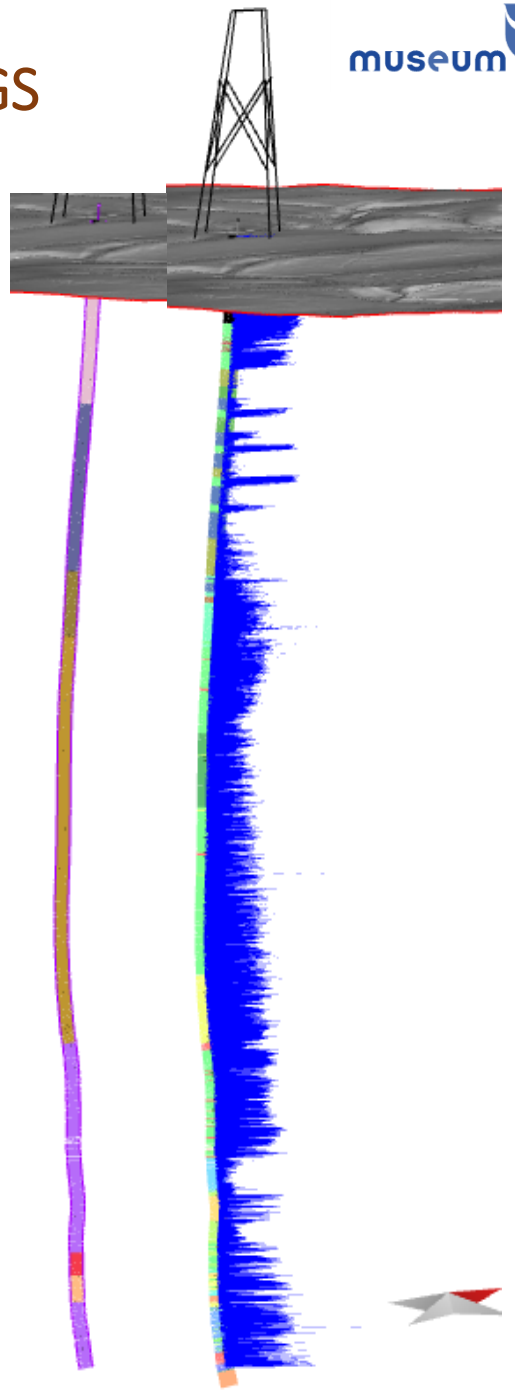



# Havelange case-study: 3D model for potential EGS




- Logging data digitalized
- Seismic profiles reinterpreted
- 3D Model of the Lower Devonian reservoir





# 6. Conlusions

- There is a large potential for DGE In Wallonia at different depths for a large scope of use (from low to medium enthalpy)

- Promising zones of interest (as the Dinantian reservoirs) in the Variscan front and below the midi Fault are present in the regions with the highest population density, and where the demand for heat/electricty is greatest : the Sambre-Meuse valley…

- The Mons basin should be more extensively exploited since the resource is well recognized

- Further investigations will be conducted and will need to go further in the central and eastern part of Wallonia to fully discover the promising horizons and characterize them (depth, thickness, temperature, permeability)

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# Thank you for your attention!