GEOTHERBAMINE

GEOTHERmie dans le BAssin MINier du Nord – Pas-de-Calais

FRANCE 2030

PROGRAMME DE RECHERCHE
SOUS-SOL

Franck Bourdelle, *ISTeP – CY Cergy Paris Université* / Olivier Averbuch, *LOG – Université de Lille* / Cyril Durand, *LGCgE – Université de Lille* / Claire Bossennec, *LOG – Université de Lille* / Laurent Beccaletto, *BRGM Orléans* / Adriana Traby, *IFPEN* / Fabien Graveleau, *LOG – Université de Lille* / Béatrice Ledésert, *ISTeP – CY Cergy Paris Université* / Ronan Hébert, *ISTeP – CY Cergy Paris Université* / Rémi Leprêtre, *ISTeP – CY Cergy Paris Université* / Emily Lloret, *LGCgE – Université de Lille* / Annette Hofmann, *LOG – Université de Lille* / Louis Largillière, *LOG – Université de Lille* / Renaud Divies, *IFPEN* / Raphaëlle Petit, *IFPEN* / Frédéric Lacquement, *BRGM Orléans* / Stéphane Marc, *BRGM Orléans* / Thomas Guéant, *ENGIE* / Hugo Duwiquet, *ENGIE* / Hadi Rammal, *ENGIE* / Quentin Campeol, *UMons* / Olivier Kaufmann, *UMons*

Understanding fluid circulations in the subsurface of the former Nord – Pas-de-Calais mining basin to assess its geothermal potential

CONTEXT

To meet the demand for carbon-free and renewable energy, geothermal projects are multiplying in geologically well-known and less complex regions, such as sedimentary basins or fractured bedrock. However, to successfully achieve the ongoing energy transition, this opportunity must be made accessible to all industrial hubs and urban living areas, even if the local geosystem is complex and the economic risk of exploration is higher.

To help reduce this risk and accelerate exploration, **GEOTHERBAMINE aims to constrain a complex geothermal system located beneath a highly structured basin, which is also a densely populated and industrially active area: the former mining basin of Nord – Pas-de-Calais (France).** Although this region is one of the least explored in terms of geothermal potential, hot fluid circulations can be identified under the coal basin. This potential has already prompted our Belgian neighbors to drill a geothermal project near Mons, with production results still satisfactory 40 years after the start of exploitation (Fig. 1).
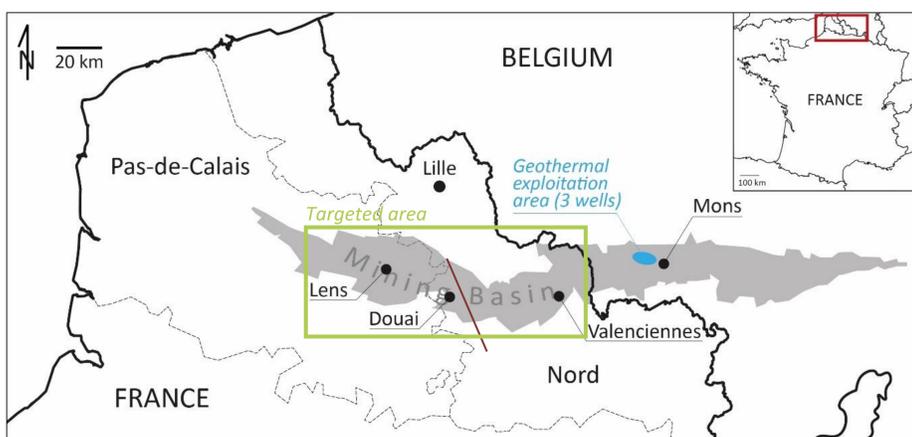

Fig. 1 : Location of the mining basin and the targeted area

At the regional scale, however, the temperature of deep waters is heterogeneous. Two deep aquifers (~2–4 km depth) are potential targets for geothermal development: the brecciated/karstic limestones of the Visean (347–331 Ma) and the limestones of the Givetian-Frasnian (390–372 Ma). These aquifers are buried beneath thick Carboniferous shale and sandstone units – formations exploited for coal over three centuries – that formed in a foreland basin along the northern thrust front of the Variscan orogenic belt (Fig. 2).
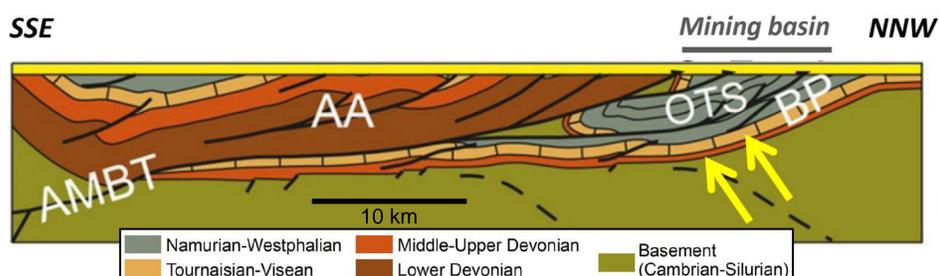

Fig. 2 : Simplified cross-section through the mining basin, from Laurent et al. (2021). Yellow arrows indicate the targeted reservoirs.

THE GEOTHERBAMINE PROJECT

GEOTHERBAMINE aims to understand the thermal properties and fluid circulations within the mining basin and its substratum (reservoirs and carbonifereous units) by…

→ **re-evaluating the 3D structure of the mining basin at different scales, including 300km of new reprocessed seismic lines,**
→ **characterizing fluid circulations and their evolution over time combining all the geochemistry methods and experimental geomechanics data, and**
→ **modelling the evolution of the basin, fluid circulations, and the resulting thermal properties over time using advanced tools: TemisFlow, Kine3d-3 and KronosFlow.**

GEOTHERBAMINE will therefore open new perspectives for a region not currently covered by PEPR targeted projects, **with the aim of supporting decision-making regarding the exploitation of this area.**

The project is structured around 4 work packages (Fig. 3), **designed to characterize and quantify the geothermal potential,** plus an additional 5th work package focused on societal issues, especially regarding the acceptability of this new subsurface use in an area heavily influenced by its mining past and carbon resource exploitation.
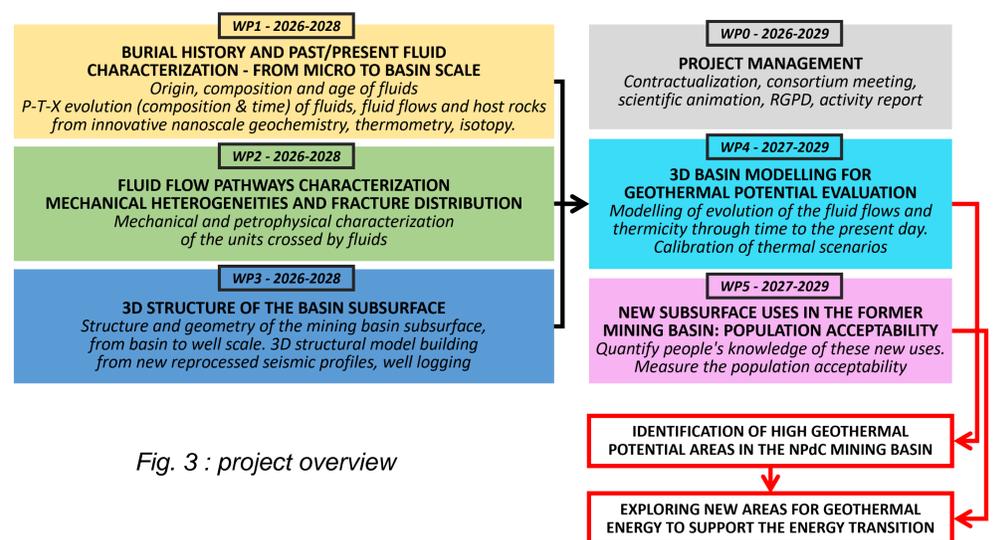

Fig. 3 : project overview

THE GEOTHERBAMINE CONSORTIUM

GEOTHERBAMINE gathers experts in geochemistry, mineralogy, thermometry, petrophysics, basin geology, 3D structural & thermal modelling, from 3 French laboratories – ISTeP from CY Cergy Paris Université, LOG and LGCgE from the University of Lille – and 2 French research organizations, IFPEN and BRGM. The consortium will also benefit from the contributions of ENGIE, one of the first energy companies to obtain an exclusive exploration license in the former mining basin, and the University of Mons (Belgium), which is heavily involved in developing deep geothermal energy in the Belgian part of the mining basin. As a result, the consortium is reasonably sized to ensure maximum flexibility and efficiency and is built on all the necessary expertise and fruitful collaborations, enabling us to propose this well-structured and structuring project.

• Laurent et al., 3-D Structure of the Variscan Thrust Front in Northern France: New Insights From Seismic Reflection Profiles. 2021. Tectonics, 40, e2020TC006642