

## **Modelling the geometry of abandoned coal mines for inter-seasonal underground storage of heat and cold**

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Wallonia (southern Belgium) experienced intense coal mining in the 19th and 20th centuries. The depths of these abandoned coal mines range from the ground surface to more than 1000 m. These abandoned mines are now being studied as potential reservoirs for inter-seasonal geothermal storage operations as part of the operation of 5th generation heating networks. In the scope of feasibility studies, a major challenge is to reconstruct the geometry of former structures and works, a preliminary but essential step in modelling flows and heat transport underground.

As these mines have been closed for a long time and are no longer accessible, this work is essentially based on archive documents such as mining maps from the former coal mines and cross-sections conserved by the mining administration. The information available in these documents is invaluable. However, this information, some of which dates back more than a century, is sometimes difficult to interpret and cannot be considered exhaustive. Moreover, it is not homogeneous and the accuracy of the topographical information varies depending on the source and the time period.

In order to reconstruct a coherent 3D model of the mine workings (galleries, panels and shafts), a geological model constrained by information from archival documents is built. Next, the elevation of panel and drift boundaries in layers is adjusted on layers derived from the geological model to preserve topological links between objects. Then, a discretized model representing areas of increased permeability around the construction sites and galleries is extracted. Finally, this model is reused to build a 3D thermo-hydrogeological model, which is used to simulate flows and heat transport in the potential geothermal reservoir, in different geothermal exploitation scenarios.

To carry out all these operations and the associated quality controls, a workflow based on developments in Python and relying on open source libraries has been developed and tested.