QUANTIFYING THE TRANSFERABILITY OF HYDRAULIC PARAMETERS USING GEOSTATISTICS: THE BOOM CLAY CASE

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The Boom Clay is currently investigated as potential host formation for the deep disposal of high-level and/or long-lived radioactive waste in Belgium. Deep disposal safety relies on multiple barriers: the "supercontainer" containing the vitrified waste, the repository itself and the host formation in which the disposal could be constructed. The latter is the most important as it is the one that has to slow the migration of radionuclides towards the biosphere for a sufficiently long time when the man-made barriers are no longer effective. So it is the site's geology that must ensure that the long-term radiological impact of the waste in the repository stays below the nationally and internationally allowable limits and is therefore significantly lower than natural radioactivity.

The Boom Clay is a marine Oligocene clay of approximately 100 m thick deposited in the North Sea basin. It is known in Germany, The Netherlands and Belgium as a continuous layer gently dipping (~ 1°) towards the north-north-east but also gaining thickness in this direction. One of the most remarkable characteristics of the Boom Clay is its structure of bands that are several tens of centimeters thick, reflecting mainly cyclical variations in grain size (silt and clay content).

The Boom Clay aquitard requires to be precisely characterized in terms of hydrogeological parameters, to confirm its role of geological barrier between its surrounding aquifers. Therefore, hydraulic conductivity and diffusion parameters have been intensively measured at only a few boreholes in Belgium, mainly located in the Mol-Dessel area, assuming a good lateral continuity of the geology. This assumption needs to be validated by quantifying the transferability of the hydraulic parameters from well sampled to scarcely covered areas. Combining core measurements with more densely acquired geophysical information allows quantifying their spatial variability and bringing promising answers.

From a methodological point of view, the 3D modeling of hydrogeological parameters requires to solve several issues. First, it is required to find a consistent geo-reference system allowing to laterally correlate thin observations derived from boreholes separated by several tens of kilometers. Then, in order to provide a reliable 3D model, it is compulsory to integrate the correlation between the scarcely sampled target parameters (core measurements) and numerous geophysical logs (gamma ray, resistivity). Geostatistics provides a suitable framework to solve these issues.

Finally, a 3D model of the target parameters is proposed, together with an uncertainty envelope. This uncertainty quantification is of significant added value to assess the efficiency of the geological barrier.

Besides the actual modeling of targer parameters, the paper also presents sampling recommendations for forthcoming boreholes.