Site Investigation of the Natural Geological Barrier of a Rock Quarry as a Potentially new Landfill site

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In Norway, landfill sites are often established in old rock quarries. To assess the quality of the surrounding bedrock as a natural barrier it is vital to understand the fracture network and their inter connectivity as these can provide routes for groundwater flow towards the interior of the quarry and pathways for contaminants out of the site. Different sources of information can be considered. Aerial photos can be used to map major and minor lineaments as well as their continuity. Borehole logs and time series of groundwater level, and pumping data collected from the quarry drain system can also be analysed. Water collected from specific fractures, and analysis of isotope ratios can also provide valuable information about sources of groundwater recharge.

We will present the interpretation of aerial photos, and data from 8 observation wells drilled in the circumference of the Rekefjord rock quarry in southwestern Norway. The geology of the quarry consists of Norite, a mafic intrusive igneous rock composed of a mixture of massive medium sized Monsonorite (1-5mm), dominated by plagioclase and the dark mineral orthopyroxene (NGU, 2016). Structural interpretation indicates randomly distributed orientation of the fractures. The bore hole logs indicate that there could be several vertical fractures, these are not well captured in vertical boreholes, therefore a Terzaghi correction was applied (Sanderson & Nixon, 2015; Terzaghi, 1965). Most of the fractures appear wide with an aperture size between 2 mm and 10 mm. Fracture connectivity and various topological parameters were also investigated. The average degree of connection (D) varies between 3.09 to 1.92, indicating that some parts of fracture networks are better connected than others. Well-connected fractures will have the largest potential for groundwater flow. Previous Lugeon tests (Slinde, 2021) for different sections of the boreholes, range from 1.6×10^{-10} ms^{-1} to 1.2×10^{-6} ms^{-1}. No relationship between hydraulic conductivity and fracture frequency was observed. Based on the different datasets, we will present a preliminary conceptual groundwater model for the rock quarry and its surroundings.

References

Sanderson, D. J., Peacock, D. C. P., Nixon, C. W., & Rotevatn, A. 2019, Graph theory and the analysis of fracture networks. *Journal of Structural Geology*, *125*(April 2018), 155–165. https://doi.org/10.1016/j.jsg.2018.04.011

Terzaghi, R., 1965, Sources of Error in Joint Surveys. *Géotechnique*, 15, 287-304. https://doi.org/10.1680/geot.1965.15.3.287

Norwegian Geological Survey, NGU, 2016, Vurdering av geologisk forhold ved potensielle lokaliteter til deponi for uorganisk farlig avfall. NGU rapport nr. 2015.055

Slinde, G.A, 2021, Miljørisikovurdering, DEPONI FOR ORDINÆRT AVFALL I REKEFJORD, NGI rapport, DOK.NR. 20200407-01-R, REV.NR. 0 / 2021-05-26