EGU21-7000, updated on 19 Jun 2021
https://doi.org/10.5194/egusphere-egu21-7000
EGU General Assembly 2021

A geoscientific site descriptive model for the Äspö Hard Rock Laboratory, SE Sweden

Jesper Petersson[1], Peter Hultgren[2], Mansueto Morosini[2], and Frédéric Mathurin[3]
[1]Geotechnical Engineers of Sweden AB, Göteborg, Sweden (jesper@geos.se)
[2]Swedish Nuclear Fuel and Waste Management Company, Stockholm, Sweden (peter.hultgren@skb.se, mansueto.morosini@skb.se)
[3]BRGM, Orléans, France (f.mathurin@brgm.fr)

The development of an updated geoscientific site descriptive model (SDM) is currently in progress for the Äspö Hard Rock Laboratory (Äspö HRL), the key underground research facility of the Swedish Nuclear Fuel and Waste Management Company (SKB). Äspö HRL is located in south-eastern Sweden, within a suite of 1.81–1.76 Ga granitoids, and consists of a tunnel system down to 460 m depth with a total length of about 5 km. Tectonically, the area is part of a contractional shear belt, primarily manifested by a NE-SW trending regional deformation zone, which partly transect the underground facility. The shear zone system has evolved gradually over a prolonged period, with an initial low-grade ductile development, followed by multiple events of brittle reactivation. The structural framework is characterised by a significant heterogeneity in the hydraulic flow properties, where the most transmissive structures belong to a set of less extensive, conjugate zones and fractures.

More than 30 years of studies, starting with the pre-investigations and construction of the facility, have generated a wealth of geoscientific data in 3-D space, and hence a sound basis for an update of existing models. The SDM under current development aims to present an integrated geoscientific understanding of the Äspö site, with special focus on geology, hydrogeology and hydrogeochemistry. The general working procedure includes basically an initial stage of data capture, followed by an intermediate interpretative stage, and finally the construction of 3-D models with associated concepts and parameters. An explicit goal throughout the work has been to encourage interaction between the different geo-disciplines, especially during the interpretative stage, as a forerunner to the final stage of deterministic/conceptual modelling. During the interpretative stage, geological and geophysical information were combined into two basic building blocks along individual boreholes, tunnels, and outcrops: rock units and possible deformation zones, which were assigned hydraulic parameters such as primarily K-values. The subsequent geological 3-D modelling comprises two components: rock domains and deformation zones with a surface trace length of ≥ 300 m. Hydrogeological feedback was provided in terms of K-anisotropies and depth trends.

The fundamental outcome of the modelling is a more profound conceptual understanding, along with geometries and properties for each domain or zone. Additional outcomes are data on and

understanding of the effects of 25 years of artificial tunnel drainage on groundwater pressures, flow and chemistry. The natural groundwater system, originally formed by paleoclimatic and geological factors over a vast period, has be profoundly influenced by important monitored phenomena. Upflow of deep-lying saline water and extensive intrusion of current seawater disclose the apparent hydro-properties and interconnection between deformation zones.

Currently, geological 3-D model includes geometries for ten rock domains and 24 deformation zones, the latter with seamless transitions to zones of the regional scale Laxemar model, as developed by the SKB with the objective of siting a geological repository for spent nuclear fuel in the proximity to the Äspö HRL. As completed, the models will serve as framework for more detailed-scaled facility models.