# Geological characterisation of geophysical lineaments around the planned repository for high-level nuclear waste, Forsmark, Sweden

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**The Swedish Nuclear Fuel and Waste Management Co. (SKB) is responsible for the safe storage of spent nuclear fuel in a geological repository near Forsmark, Sweden. Part of their research includes constructing deformation zone models of the bedrock in the regional area surrounding the repository site. In 2020, SKB started a project to expand this deformation zone model to encompass the entire catchment area, defined as the future maximum area where precipitation collects and runs off into a body of water (Fig. 1).**

The overall objective of my master-project has been to investigate the characteristics and extent of deformation zones in the expanded area based on field observations and within the context of already existing structural models. The results of this project can then provide a basis for a broader regional model.

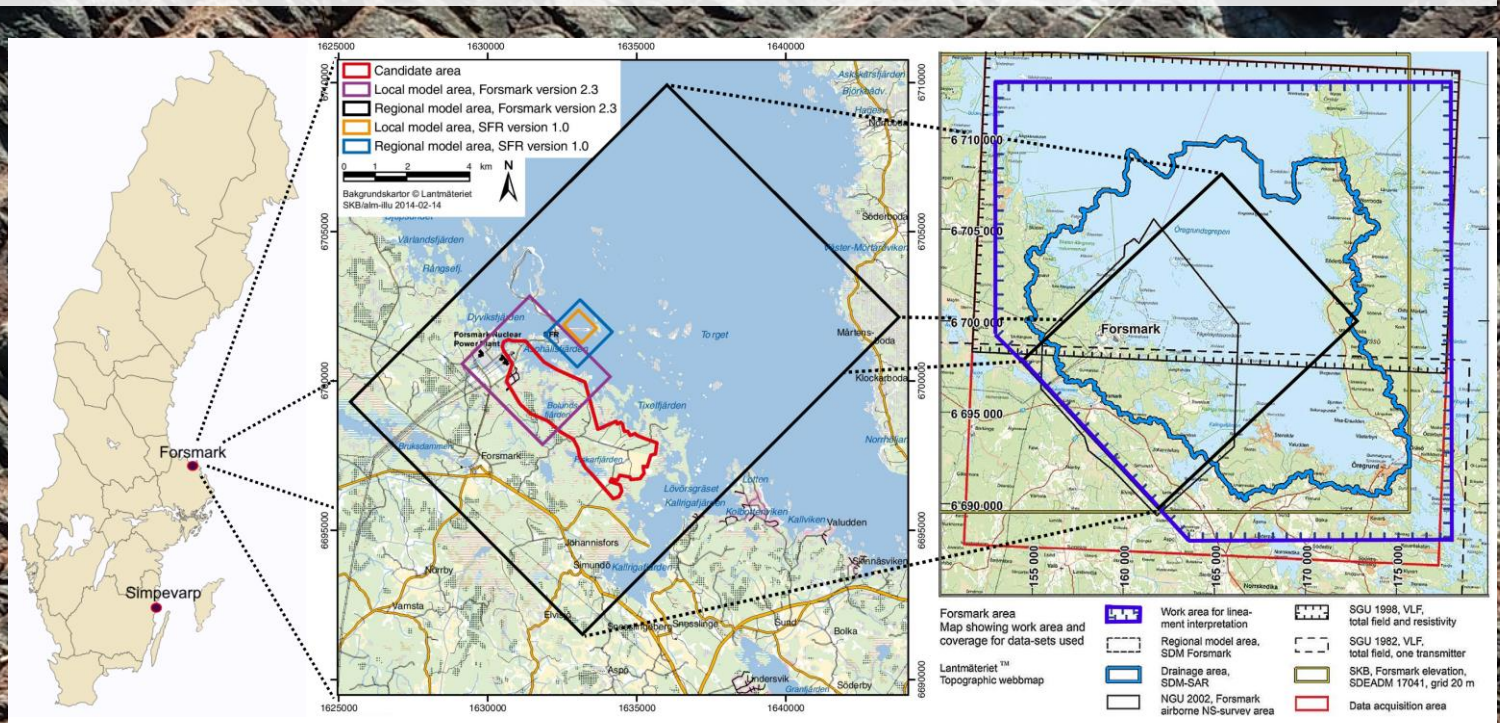
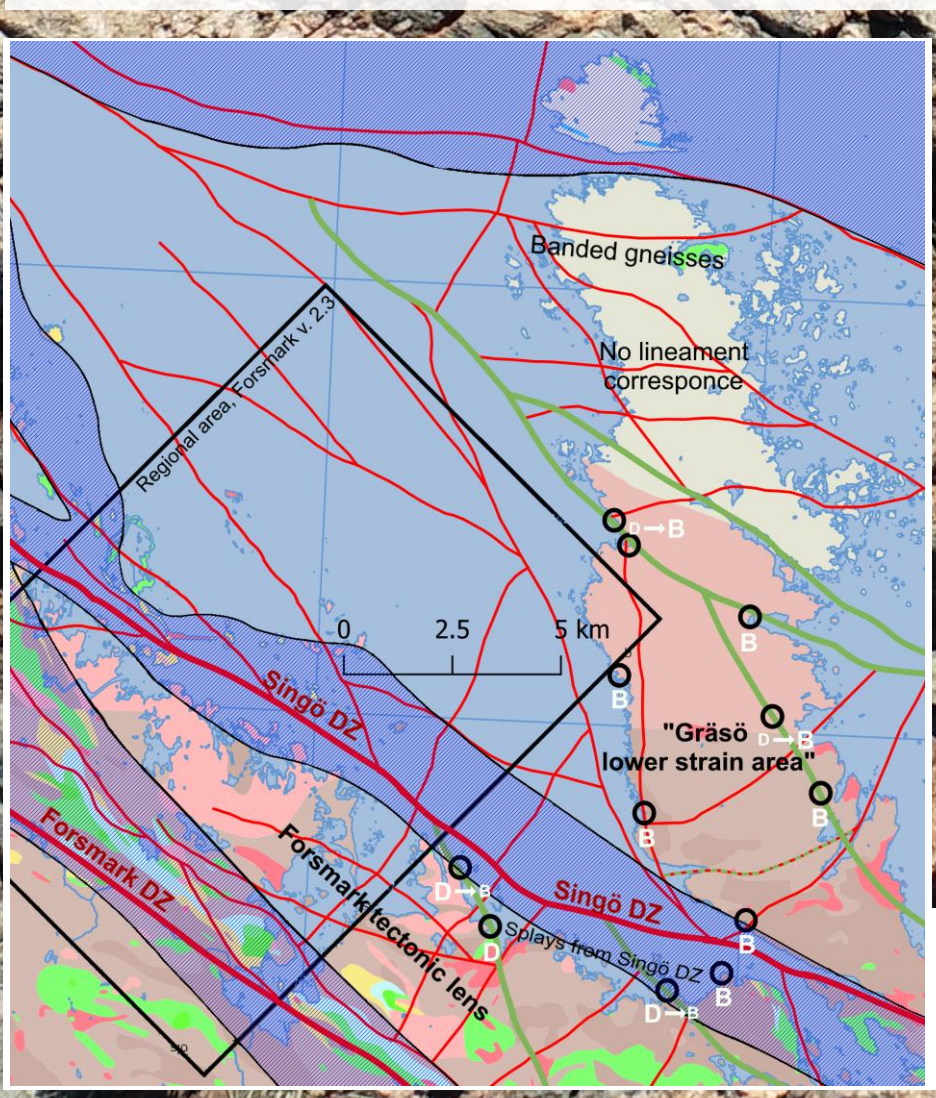



Figure 1. The extent of the regional model area (black rectangle, left) and the expanded area (dark blue outline, right) at Forsmark

The bedrock in the Forsmark area has been subjected to various stages of deformation linked to regional-scale tectonic events. During the 2.0-1.8 Ga Svecokarelian orogeny, ductile deformation resulted in a penetrative ductile fabric in crystalline basement rocks and discrete shear zones. The gneissic rocks between shear zones delimits the volume in which the geological repository is planned and makes up a lens-shaped area at the current erosional. Regional- and local scale deformation zones have been extensively studied in the past decades and visible in 3-dimensional models. The new deformation zones outside this regional area must be linked to these existing models. As a basis for this project, SKB's lineament interpretation map (provided from GeoVista AB) has been used which is based on geophysical data (magnetic susceptibility and electric resistivity) to interpret possible deformation zones.




My results show that from the large-scale Singö deformation zone, NW-SE striking splays originate, characterized by deformation zones with high degree of localized strain. Locally, these are reactivated in the brittle regime. Tens to hundreds of meters wide strongly red-stained brittle deformation zones are found on the island of Gräsö, located outside the higher ductile strain area (Fig. 2). Locally, mylonitic fabrics near the core of the zones are visible, again indicating ductile deformation prior to brittle fracturing. E-W striking red-stained brittle deformation zones host a fracture mineral assemblage of calcite, adularia and laumontite seem partly extensional in nature and are most likely related to the 1.1-0.9 Ga Sveconorwegian orogeny. Lineaments in the northern parts of Gräsö that are oriented E-W and NW-SE are parallel to the gneissic banding of the host rocks.

Figure 2. Lineament investigation results on Gräsö and the southeastern area between the Singö DZ and the Forsmark DZ. Blue shaded areas: inferred to be affected by high ductile strain. Green lineaments: Confirmed deformation zones. Black circles: Localities of found deformation zones. D & B markers stand for Ductile and Brittle, respectively and indicate which type of deformation is visible at each locality.