3D modelling of the groundwater recourses in Vombsänkan, Skåne

Farid Khorshidian

Water is essential for life on Earth, and it is the world's most important natural resource. The project is a part of the Blue Transition which is a collaboration between seven European countries. Blue Transition targets a systematic water and soil management to ensure good-quality water in the North Sea Region.

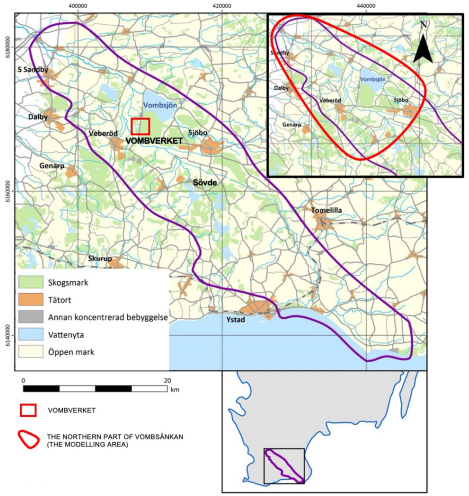


Fig. 1. Vombsänkan, southern Sweden. The area is 5 to 11 km wide and continues towards Östersjön and Bornholm (Dahlqvist et al, 2021). The location of Vombverket and the modelling area is marked on the map.

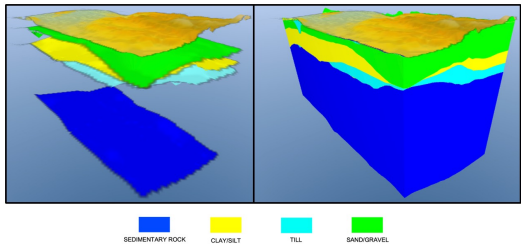
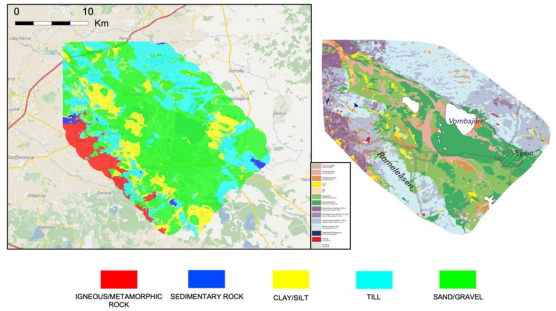


Fig. 9. Layered 3D model illustrating the stratigraphy at Vomb, South of Lake Vombsjön, which consists of four major units. The surfaces interpolated from the interpretation points and the layers created from the same surfaces are also shown.



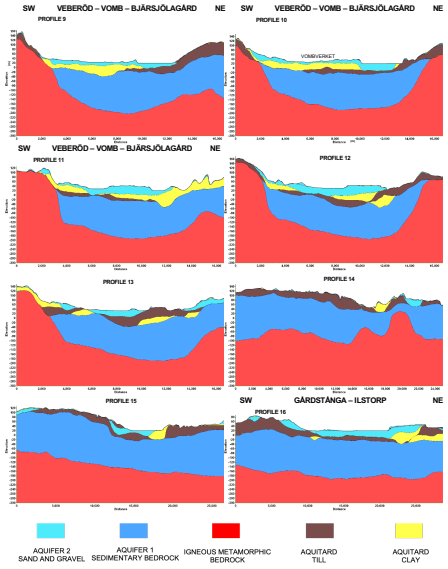


Fig. 26. Hydrogeological conceptual model of the northern part of Vombsänkan. Profiles 1-20 illustrate the hydrostratigraphic units that are defined based on their respective K values.

The water flows on the surface and joins the groundwater recourses through the uppermost geological units. Therefore, it is necessary to control the quality of the soil to ensure a safe and sustainable supply of drinking water. Vombsänkan is 759 km2 in size and has a NW-SE-directed extension from Gårdstånga in the Northwest to Kåsberga in the Southeast. At Vombverket in South of Lake Vombsjön, 1100 l/s drinking water is produced using artificial groundwater recharge.

3D modelling is considered as an emerging and favourable technique for mapping of groundwater. A new powerful tool in geological modelling is the software Geoscene 3D. However, there is no previous research available that describes the 3D modelling procedures with Geoscene 3D using the borehole data. Lack of a 3D visualization of the northern part of Vombsänkan and an instruction for the application of Geoscene 3D in modelling of a complex geological setting such as Vombsänkan, emphasizes the importance of this thesis work.

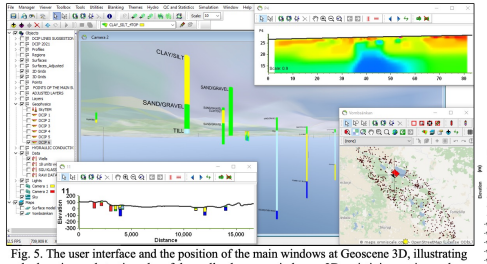


Fig. 5. The user interface and the position of the main windows at Geoscene 3D, illustrating the location and stratigraphy of the wells, the map window, a 2D resistivity section and a profile at Vombverket.

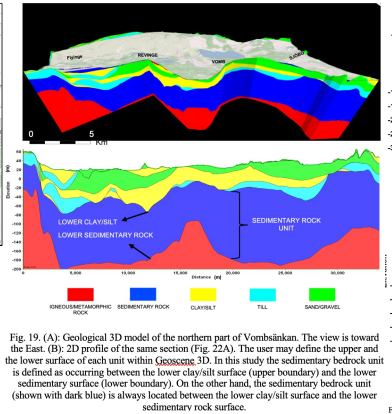


Fig. 19. (A): Geological 3D model of the northern part of Vombsänkan. The view is toward the East. (B): 2D profile of the same section (Fig. 22A). The user may define the upper and the lower surface of each unit within Geoscene 3D. In this study the sedimentary bedrock unit is defined as occurring between the lower clay/silt surface (upper boundary) and the lower sedimentary surface (lower boundary). On the other hand, the sedimentary bedrock unit (shown with dark blue) is always located between the lower clay/silt surface and the lower sedimentary rock surface.

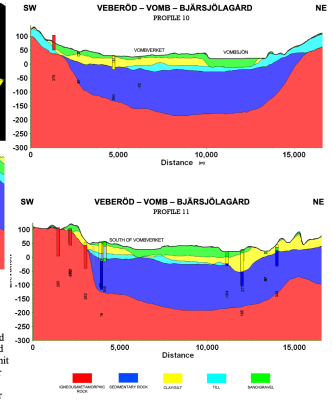


Fig. 23. Profiles 8 – 11, illustrating the geology of the Veberöd-Vomb-Bjärsjölagård zone.

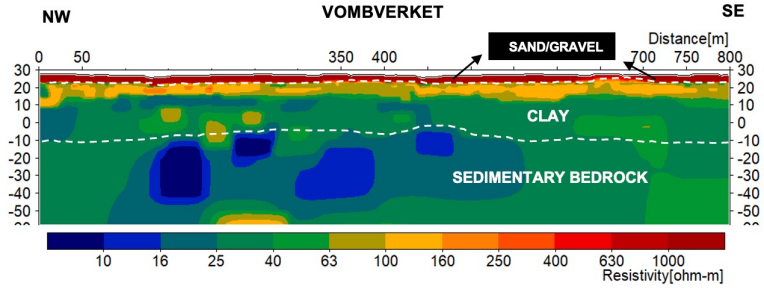


Fig. 29. Interpretation of the resistivity results at the Vombverket water treatment plant.

A new 3D model and geophysical investigations reveal the hydrogeological conditions

Two major types of aquifers are identified. Aquifer 1 is the sedimentary bedrock, which is typically a confined aquifer. Aquifer 2 commonly consists of an open aquifer near the surface, which is composed of sand/gravel. At Vombverket the depth of the Quateranry deposits is 40 – 50 m. The major groundwater recharge occurs along the horst zones at higher elevations at the margins of Vombsänkan. The estimated aquifer geometry reveals the substantial hydrogeological potential of the northern part of Vombsänkan. The approximate volume is 1.2 – 18.2 km3 for the confined aquifer associated with the porous and fractured sedimentary rocks. The open aquifer within the sand and gravel unit has an approximate volume of 2.3 - 3.6 km3.

A simple hydrostratigraphic model is presented for the area around the Vombverket water treatment plant. The sedimentary bedrock is located 40 – 50 m below the surface. At some locations, such as East of the infiltration basins, a till unit covers the bedrock.

However, at the location of the resistivity measurements, 25 – 30 m of clay is directly deposited on top of the sedimentary bedrock. The uppermost unit is composed of 5 to 10 m of sand and gravel.