

Three-dimensional geologic modeling of the Virttaankangas aquifer, southwestern Finland

Artimo, A.¹, R.C. Berg², C.C. Abert², J. Mäkinen³ and V.-P. Salonen⁴

¹Department of Geology, FIN-20014 University of Turku, Finland; ²Illinois State Geological Survey, 615 E. Peabody, Champaign, IL 61820, USA; ³Department of Geography, FIN-20014 University of Turku, Finland; ⁴Department of Geology, FIN-00014 University of Helsinki, Finland; E-mail: A. Artimo at aki.artimo@utu.fi

Introduction. The Virttaankangas glaciofluvial/glaciolacustrine complex is part of the largest esker system in southwestern Finland (Fig. 1). A plan has been prepared for the area that will involve the production of an artificial groundwater reserve from infiltrated river water for the use by the city of Turku and its surrounding area. The amount of river water infiltrated into the esker aquifer will be about $1.3 \text{ m}^3 \text{ s}^{-1}$. This is about 0.5 % of the mean flow of the River Kokemäenjoki, which will be the initial source of the water (Jaakko Pöyry Infra 2001). The artificially infiltrated groundwater will be supplied to 285,000 inhabitants of the Turku area in the beginning of the year 2007.

The complex structures within the unconsolidated Quaternary deposits hosting the groundwater reserve needed to be mapped in detail. Therefore, a three-dimensional (3-D) hydrogeological conceptual model of the Virttaankangas area that identified and characterized the main hydrogeological units of the aquifer, was constructed. This model, along with subsequent groundwater flow models, will be the keys in planning and guiding both the infiltration of the river water into the aquifer and pumping of the resulting groundwater from the aquifer to the Turku area.

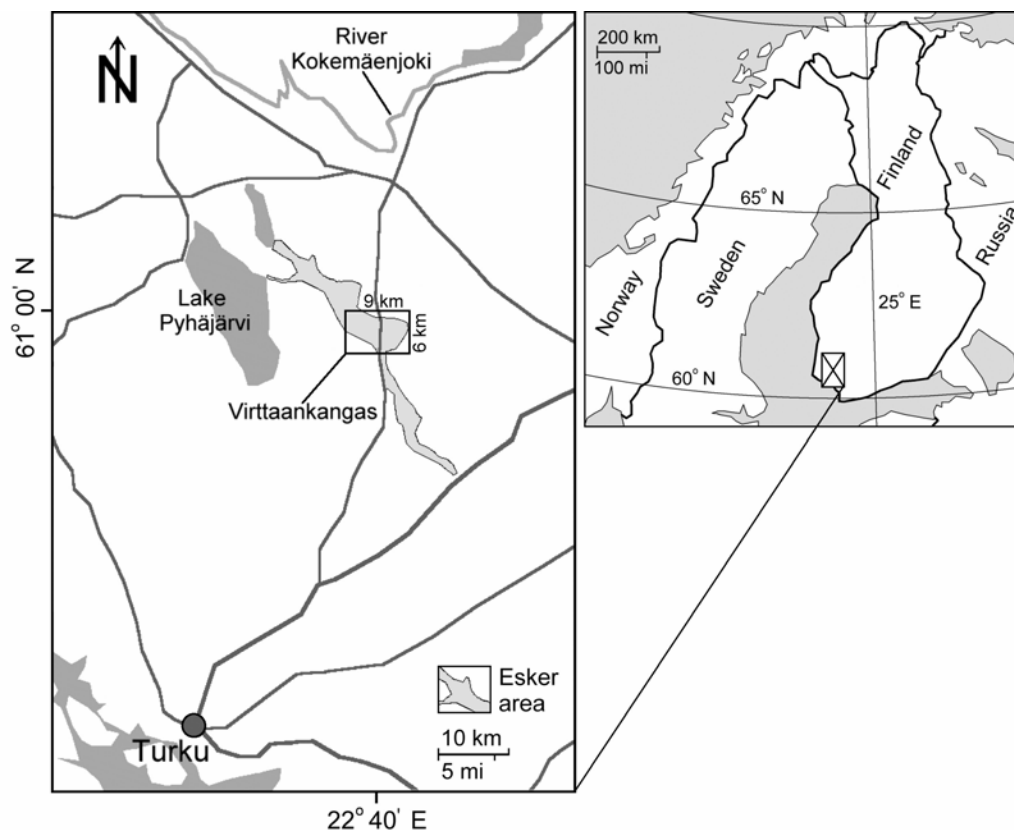


Figure 1. The location of the study area.

Research material. The Virttaankangas area has been the object of numerous geological investigations since the 1960's. The research data obtained from the previous studies includes 131 drilling logs, ground penetrating radar soundings, seismic soundings, gravimetric measurements, permeability tests, and pumping tests. Recent sedimentological interpretations of the area (Mäkinen 2001) have provided a new framework to combine all the research data into a 3-D hydrogeological model of the Virttaankangas aquifer.

Methods. The major hydrogeological units of the aquifer identified based on the available data include the relatively impermeable bedrock, one till unit, a coarse grained glaciofluvial unit, a glaciofluvial/glaciolacustrine unit, a glaciolacustrine clay and silt unit, and a littoral sand unit (Fig. 2). The architecture, as well as preliminary interpretations of the hydraulic properties of the units, were defined.

The 3-D mapping project was done in cooperation with the University of Turku and the Illinois State Geological Survey. Data were prepared with Surfer® software and the final 3-D modeling was done with EarthVision® geologic modeling software. The Virttaankangas 3-D model was also introduced to the EarthVision Viewer® program, which offers flexible and versatile functions to view the extent and structures of the hydrogeological units of the model.

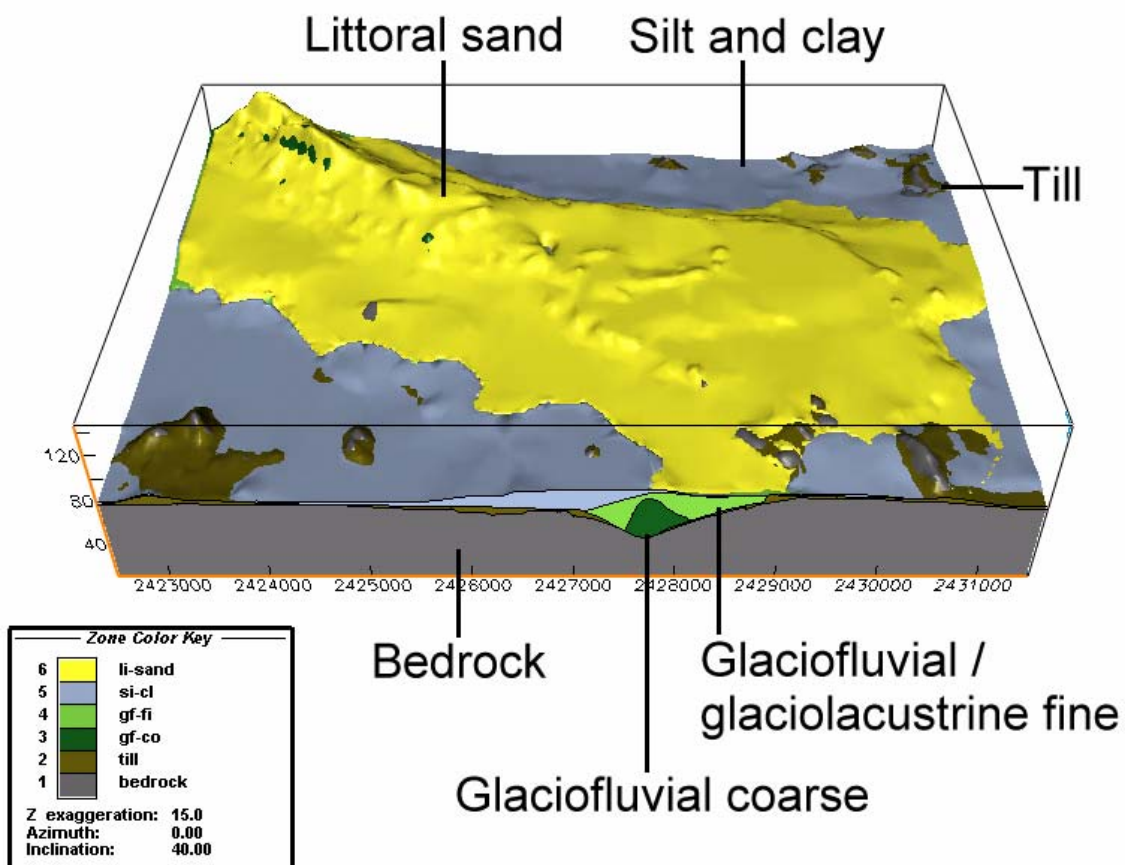


Figure 2. The hydrogeological units of the 3-D model.

Conclusions. The 3-D hydrogeological model provides a tool to visualize the aquifer, to locate suitable infiltration areas, and to protect the aquifer from possible contamination. Furthermore, the 3-D geological model can be used in groundwater flow modeling to provide a geologically consistent conceptual model of the study area. This also includes the interpretation of the vertical and areal distribution of hydraulic properties within the modeled units. The experiences obtained from this study can be further applied to other glaciated regions in Europe and North America.

Additional material about the Virttaankangas 3-D model can be found from the following Internet address: <http://users.utu.fi/a/akartimo/3dmodel/english/>

References

- Jaakko Pöyry Infra, 2001. Turun Seudun Vesi Oy, Turun seudun pohjavesihanke – Ympäristövaikutusten arviointiselostus. 00125213, 142 pp., 9 appendices.
- Mäkinen, J., 2001. Säkylänharjun-Virttaankankaan harjumuodostuman rakenne ja kehitysvaiheet – Asiantuntijalausunto. Unpublished sedimentological report.