# Preface

Writing a book that summarises everything we know about hydrogeology in hard rocks would be an impossible task. It has not been a particularly easy task to write a book that summarises what a rock engineer should know about hydrogeology, but it has been an exciting and challenging project.

By rock engineer, I am referring to everyone involved in an underground construction project – client, investigator, designer and contractor. The book is aimed primarily at skilled investigators and project designers with sound fundamental expertise but who need more in-depth understanding in this field. The reader should be curious about the relationships between rock and groundwater, and be motivated to understand them better. I strongly believe that if you understand something, you not only do a lot right but also avoid many errors. If this book can contribute to that, then I am satisfied. I also hope that the book will be useful in undergraduate courses and Masters programmes at higher education institutions.

Most tunnel projects involve considering issues about impact on groundwater. Water that flows into the tunnel can lower the groundwater level, causing settlement that can damage buildings, and can also affect the quality of the groundwater. Water issues have attracted greater attention since the Swedish Environmental Code was adopted, and also through the well-publicised sealing problems in the Hallandsås Tunnel in southern Sweden. Specifications relating to dripping and moisture in tunnels have also become more stringent in recent years, particularly with regard to frost which can constitute a risk to safety and result in considerable maintenance costs. In Gothenburg, the Lundby and Göta tunnels are examples of projects where construction in rock that was sensitive to settlement necessitated strict sealing requirements. The Göta Tunnel also exemplifies how even a relatively small inflow in a limited area can affect groundwater levels in a confined aquifer, in this case a typical geological environment where impermeable clays overlie a thin layer of water-conducting non-cohesive soil.

In the near future, a large number of tunnels will be built, many of them facilities of great complexity. In many cases, the hydrogeological solutions will be crucial in the selection of design and technology. This forms the background to this book. The subject was considered in a report by the Rock Engineering Research Foundation (BeFo) in 1986, many parts of which still apply. However, greater awareness, technological development and experience, not least from the extensive research and experiments carried out at the Äspö Hard Rock Laboratory of the Swedish Nuclear Fuel and Waste Management Co. (SKB), have motivated a new publication with broader and more comprehensive content.

Many people have played a part in making this project possible. Firstly, I wish to thank my funding bodies: Chalmers, the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (Formas), the Rock Engineering Research Foundation (BeFo), the foundation J. Gust. Richerts minne, the Development Fund of the Swedish Construction Industry (SBUF) and the Swedish Construction Federation. I particularly wish to thank the reference group that provided valuable advice during the work: Lars-Olof Dahlström, Tommy Ellison, Tomas Franzén, Ola Landin, Magnus Liedholm, Arvid Taube and Pär Åhman. Special thanks also to my colleagues Åsa Fransson, Karin Holmgren and Patrik Vidstrand, who have reviewed the text and diagrams and supported in other ways. An important asset has been the data and figures from SKB research and studies, which SKB made available so generously.

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Finally, my heartfelt thanks go to my wife Lena. Without a single word of protest, and keeping a healthy distance to the mysterious world of groundwater, she put up with me sitting in the attic in our country house, at my mother-in-law's dining table, and in many other places, totally preoccupied, with my focus on the computer screen.

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*Gunnar Gustafson*

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