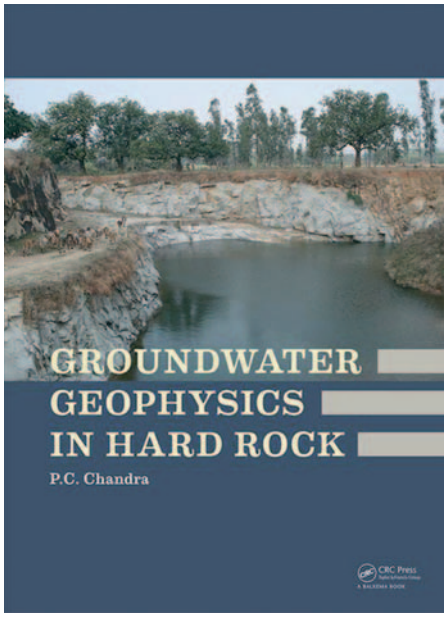
10.1071/PVv2017n186p41

Groundwater geophysics in hard rock

By Prabhat Chandra Chandra



Publisher: CRC press, 2015, 384 pp.
RRP: £66.99 (hardback); £46.89 (eBook)
ISBN: 978-0-415-66463-9

This book sets out to address the specific problem of using geophysical techniques in hard rock environments. It offers case studies that range from the local to regional scale. The initial section is composed of four chapters; in the first two the reader is introduced to different aquifer types and the hydrogeology of hard rock environments. This section also provides some facts on trends in the use of groundwater from a global perspective.

In chapters three and four the use of geophysics, planning of surveys and what information can be expected as deliverables from these surveys is discussed. The author suggests information such as aquifer thickness, bedrock delineation, location of fracture zones, and lateral continuity, (amongst others) are products extractable from the geophysical data.

The core of the book is concentrated in the next eight chapters (five to twelve). These explain, in some detail, the basic principles, field-procedures and interpretations of different geophysical methods such as magnetics, resistivity, self-potential, electromagnetics, and variations of these techniques.

An important part of planning a geophysical survey is setting realistic expectations of what the employed technique can and cannot deliver; this is not always possible to foresee and most of the time this insightfulness comes only through experience. Most readers, as I was, would be familiar to some extent with the majority of geophysical techniques presented in the book, however individual levels of understanding will vary according to personal interest or exposure to the particular methods. I was particularly interested in the two chapters on the Mise-A-La-Masse and the Self Potential methods, both of which are not commonly employed techniques. The book is also a good guide to the strengths and weaknesses of the geophysical methods discussed.

There is enough detail in these middle eight chapters for readers to understand the essence of different geophysical techniques and what they can be used to achieve. The book also provides sufficient references to the literature for a more in-depth immersion, if that it is what is sought.

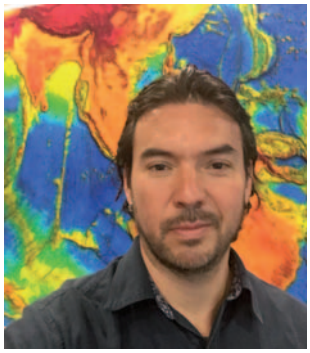
For most of the geophysical methods reviewed case studies from the subcontinent are presented. Through these case studies the author portrays different aspects of conducting geophysical surveys in hard rock environments.

In the closing two chapters the author advocates strongly for the integration of different geophysical methods, by which quantitative parameters such as the thickness and extent of the saturated/unsaturated zones can be determined. He explains how these parameters can assist in characterisation and delineation of the architecture of hard rock aquifers. The author further separates activities and research on hard rock geophysical methods into two domains 1) where the methods are grouped as quantitative measuring tools, and 2) where the measurements and their by-products are transformed into hydrogeologically meaningful outputs.

Dealing with the problem of scale is also discussed. Geophysical surveys are used for two reasons in ground water studies: (1) to determine the suitability of previously selected sites; or (2) for reconnaissance and selection of suitable sites from a larger, more regional area. The author suggests which methodologies might optimally address regional, local and detailed targets. He reviews a range of techniques from satellite, airborne and ground to borehole scale studies. There is also mention, and a brief explanation, of methods such as seismic, ground penetrating radar and nuclear magnetic resonance, and a discussion about how these methods can complement other geophysical techniques explained in greater detail earlier in the book.

The final chapter has been reserved for showcasing the role of geophysics in managed aquifer recharge and for monitoring groundwater contamination. A concluding summary on the broader topic of groundwater geophysics in hard rock environments may have been more appropriate, but I believe that consideration of these applications was placed in the final chapter to demonstrate how geophysical methods can inform hydrogeological knowledge of an area, enhance it, and then be transformed into a tangible product.

Several of the topics covered in this book are clearly applicable beyond the hard rock environment, particularly the suggested approaches on integration and transformation of geophysical measurements to hydrogeologically meaningful products. The book does a good job in reviewing some of the existing geophysical methods used for groundwater exploration and provides the reader with enough information to study when selecting a geophysical method to answer hydrogeological questions.



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