Groundwater Age


The modern world puts increasing pressure on scarce groundwater resources and threatens their quality, especially in arid and semiarid regions. Sustainable yield of an aquifer depends on how quickly its water is replaced, and its susceptibility to contamination depends on how quickly water migrates from potential zones of contamination. Accordingly, groundwater studies often revolve around determining the time elapsed since water entered the subsurface. Historically, this inquiry has often been phrased, “How old is the water?”. The science surrounding groundwater age is mature enough to provide clear answers in many cases, though notable difficulties with interpretation and fundamental gaps in methods preclude useful answers in other cases.

This book provides an exhaustive, systematic review of groundwater age dating techniques, using radioactive isotopes, anthropogenic tracer compounds, and radiogenic isotopes. It includes methods useful for the entire age spectrum, from modern waters subject to potential contamination to ancient waters in deep, potentially overexploited aquifers. Recent developments, such as the atom trap method for \(^{81}\text{Kr}\) analysis, are included, and most of the methods seem up to date. For each method, the book summarizes underlying theory, analysis and sampling techniques, advantages and disadvantages, and relevant case studies. Abundant citations, including many very recent ones, are provided.

This review of methods fills about half the book and will be of great use to a wide range of people, from scientists seeking to integrate these methods into their advanced studies to policymakers who need to interpret existing data.

The rest of the book provides introductory and historical material, and addresses the issue of data interpretation. It is tempting to interpret a single measurement by stating that the water is a certain number of years old. In reality, any water sample is a mixture of waters that entered the subsurface at different times and followed different paths to the sampling point. Chapter 7 provides a review of recent research on this topic, and earlier chapters introduce this idea in general. Some of the other introductory material, such as the discussion of the geological time scale, seemed extraneous and some sections could have been more concise. But overall, the book does a good job of introducing the reader to the often-overlooked complexity in interpreting the deceptively simple results of age dating.

Academics who work with groundwater age dating, and professionals who may use dating as a means of managing groundwater resources or predicting contaminant migration will find this to be the most detailed and current reference on the subject. Its content overlaps considerably with Environmental Isotopes in Hydrogeology by Clark and Fritz and Chemical and Isotopic Groundwater Hydrology by Mazor. However, the sections on age dating are much shorter in those books, and important advances have been made since they were written. In this book, the systematic layout and mostly clear writing of the chapters on dating techniques eases the task of sorting through the various methods, assessing their strengths and weaknesses, and finding key references containing more detailed information. This should help practitioners with little background in age dating to find key information. On the other hand, the book provides an essential high-level reference for graduate research and advanced graduate hydrogeology classes involving groundwater age measurement.

T.M. Johnson*
Dep. of Geology
Univ. of Illinois at Urbana-Champaign
Urbana, IL 61801

doi:10.2134/jeq2008.0001br
Received 2 Jan. 2008.
*Corresponding author (tmjohnsn@uiuc.edu).
© ASA, CSSA, SSSA
677 S. Segoe Rd., Madison, WI 53711 USA

Published March, 2008