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Advances in Water Resources 23 (2000) 441–442

Advances in Water Resources

Book review

***Isotope Tracers in Catchment Hydrology*, Carol Kendall and Jeffrey J. McDonnell (Eds.); Elsevier, Amsterdam, 1998, ISBN 0-444-81546 (hardbound) or 0-1444-50155-X (softbound)**

There could have been no better response to the 1991 book by the NRC Committee on Opportunities in the Hydrologic Sciences. This is surprisingly so, since the bluebook pays relatively little attention to the potential benefits and applications of isotopic tracers. Nevertheless, after reading this book on *Isotope Tracers in Catchment Hydrology*, it became clear to me that the use of isotope tracers could well play an increasingly significant role in each of the five priority research areas listed in the bluebook. These are (1) chemical and biological components of the hydrologic cycle, (2) scaling of dynamic behavior, (3) land surface–atmosphere interactions, (4) coordinated global scale observation of water, and (5) hydrologic effects of human activity.

As is successfully argued by the editors in their Preface, and is also repeatedly stated in many of the chapters, for isitope hydrology to advance science and steer the research direction of Hydrologic Sciences, a multidisciplinary approach is required. Specifically, this integrated approach of collecting and analyzing isitopic data can help to elucidate the connection of hydrologic processes across spatial and temporal scales, and when used in combination with hydrological–geochemical modeling will provide new insights into the catchment or landscape scale. The scope of the book is on catchement hydrology rather than groundwater hydrology. This is a deliberate decision by the editors, which benefits our scientific field since it much clearly shows the potential and broad applications of isotope tracers. Moreover, as it becomes clearer after reading the case studies,this catchment scale point-of-view demands a system-type of approach that allows for much more optimal conditions regarding integration of physics with chemistry and biology.

The book takes on a research-oriented approach, emphasizing the benefits and limitations of both stable and radioactive isotopes in many case studies. The first few chapters of the book are of an introductory nature (Part I), and serve to familiarize the reader with the fundamentals of catchment hydrology (for the non-physical hydrologist) and isotope geochemistry (for the physical hydrologist). These are followed by various chapters on physical, chemical and biological processes affecting isotopic composition of water as it moves through the hydrologic cycle (Part II). Especially gratifying are the special efforts made to unify ttermionology and notation. Topics in this section include isotopic fractionation in precipitation, snow cover, soil and goundwater, and plants. The remainder of the book, which takes up about two-thirds, is devoted to case studies that are separated into those related to isotope hydrology (Part III) and isotope geochemistry (Part IV). Applications include the more traditional use of oxygen and hydrogen isotopes for stream flow analysis include the more traditional use of oxygen and hydrogen isotopes for stream flow analysis and identification of water sources, and extend to their application in a multitude of other hydrologic problems and chemical isotopes. For example, individual chapters are devoted to sulfur, nitrogen, carbon, and chloride isotopes and CFCs, and include the application of the more heavy radionuclides in erosion and sedimentation studies. Moreover, various chapters emphasize the benefits of a multi-isotope approach in more effectively identifying water flow and geochemical reaction paths and in gaining a broader process-level understanding than when using a single isotope. The two concluding synthesis chapters (Part V) present examples of research opportunities when integrating environmental isotope tracers can play a significant role in the study and monitoring of global environmental changes.

The multidisciplinary nature of the text is exemplified by the contribution of some 75 co-authors, who collectively have succeeded in bringing together a comprehensive review of isotope tracers in hydrology. It is to the credit of the editors in having done such an excellent job in streamlining of these many contributions with that much consistency in terminology and format among chapters. I found few mistakes, and would recommend the whole text or parts thereof graduate level courses in chemical hydrology.

Finally, I have two more comments. First, although isotope tracers have been most widely used in simple mixing models towards source contribution of water flow, I wholeheartedly agree with the editors that much can be learnt from the spatial and temporal variations of isotopic signatures, and that the unraveling of these variations in the tracer signals may significantly contribute to a better understanding of the influence of spatial heterogeneities on mass flow processes at the

PII: S0309-1708(99)00033-0

catchment scalc. Second, I have little doubt that the book will convince the hydrologic community to increasingly explore the application of isotope tracers in their research, especially since newly developed analytical technique are becoming increasingly available and interdisciplinary research to solve large-scale problems is widely encouraged.

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