

The authors have pooled a considerable amount of personal experience and also provided a theoretical background to the subject. Whilst it will probably be considered by many to be unfortunate that the whole text could not be produced in two or more languages (in separate volumes) rather than mixing French and English in the one volume, the value of having this amount of material in one volume should not be overlooked.

A variety of different contaminants is considered and the behaviour of contaminants in porous media presented. Aspects of protection policies for different aquifer types are discussed and finally a presentation of the practice of groundwater protection zones is given.

Volume 7: Hydrogeological Mapping in Asia and the Pacific Region. Proceedings of the ESCAP-RMRDC Workshop, Bandung, 1983 edited by W. F. Grimmelmann, K. D. Krampe & W. Struckmeier

UN Economic and Social Commission for Asia and the Pacific: Regional Mineral Resources Development Centre; published 198-5; 410 pp; price DM102.00; ISBN 3-922705-11-1.

The proceedings of this Workshop include reports from 21 countries, six general papers, three reports of ad hoc working groups, a list of published maps and the revised version (1983) of the International Legend for Hydrogeological Maps (IAH, IAHS, UNESCO). As with any volume of this nature there is a variety of standards of presentation but it does provide a useful basis for anyone working in any part of the ESCAP region requiring hydrogeological information. These papers indicate the status of hydrogeological map production in the various countries and indicate individuals and agencies involved with this work.

Of wider interest will be Section II, General Papers, which discuss such aspects as data requirements, the organization of mapping programmes, karstic terrains, coastal areas etc. The principles discussed here and the International Legend for Hydrogeological Maps will be of value to those embarking on hydrogeological mapping programmes for the first time.

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Water and Arid Lands of the Western United States edited by Mohammed T. El-Ashry & Diana C. Gibbons

sponsored by World Resources Institute and published 1988 by Cambridge University Press, The Pitt Building, Trumpington Street, Cambridge CB2 1RP, UK; 415 + xii pp; ISBN 0-521-35040-9.

The editors of this timely appraisal of conflicting water demands in the southwestern United States are authors of the earlier *Troubled Waters: New Policies for Managing Water in the American West*. This recent publication,

referencing works published prior to 1987, has six case studies dealing primarily with water management needs, and past practices that have led to these needs, in California, Colorado, Arizona and Texas.

Hundley describes the transformation of the Great America Desert, beginning with the mid nineteenth century. The editors have emphasized in past and present writings that public policy should promote water use within the limits of supply. Hundley's reference to the division of the Colorado's average annual flow might well have included a reference to the writings and congressional testimony of E. C. La Rue. The US Geological Survey's La Rue had unsuccessfully challenged the US Bureau of Reclamation's figures which, as Hundley points out, were based on assumed low-flow data from 1905 rather than on historic data.

Moore & Howitt are University of California agricultural economists who have addressed California's water management problems, particularly the State's salinity problems in the Central Valley farm belt, including the San Joaquin Valley where relatively good quality surface waters imported from Northern California or diverted from tributaries in the Sierras irrigate salty cropland and return to the mainstream with salt concentrations reaching 1320 ppm. They are not as familiar with the quality of groundwater, asserting that "little information is available." However, groundwater quality is well covered in several US Geological Survey publications. Since 1986, too recent to be included, the Survey has published a number of analyses, including selenium in soils and water. The authors are committed to better groundwater as well as surface water management, and as economists they have presented ways to achieve these goals.

Lacewell & Lee show that the future of the Texas High Plains is dryland crops and grazing. Depletion of the Ogallala aquifer through mining of groundwater is the cause. Megaschemes for water imports incur costs of \$330 to \$490 per acre-foot, compared to \$30 current costs for pumped groundwater. The major problem for the region is the transition from irrigated agriculture, the associated social and economic costs, and soil erosion. A major culprit is cotton, a big water user and major instigator of wind erosion. Lacewell & Lee present several approaches to easing the transition and describe why none will work. "Cost-sharing" they feel has the greatest potential, with economics overriding all else. Their conclusion is that more research and education are needed. Gradually lowering subsidies on cotton is an obvious solution and more may be needed, but is political, not scientific.

Howe & Ahrens attack the problems of the Upper Colorado River Basin and decide that "the real issues confronting the Colorado Basin are primarily institutional, not technical." They make nine recommendations concerning policy changes, which include means to "motivate retirement of unproductive acreage" and "to buy water rights ... from ... low productivity-high salinity lands." Economic benefits of in-stream flows are computed, and they support methods to pay the Upper States for those benefits so as to keep the streams flowing. One is to raise the price of the highly subsidized power, which benefits mainly the Lower States.

Vaux discusses the problems of the Metropolitan Water District (MWD) in supplying water to the burgeoning Southland of California. Construction

of facilities and taking of water from the North is the preferred alternative for MWD. Vaux shows that demand reduction through pricing (not considered by MWD in its projections), including block pricing and purchase of agricultural irrigation water, are more cost-effective. In particular, considering the salinity and selenium problems of the western San Joaquin system, land probably will be retired eventually, and other transfer of water rights will be of mutual benefit. Water marketing would raise the value of irrigation water and also lead to farm conservation practices.

Martin *et al.* discuss Tucson as a problem of politics and perception. Access to subsidized Central Arizona Project water gives a feeling that water problems are well in hand, but uncontrolled growth portends future problems. Present concern is with water quality, but in order to meet 2025 goals "all greenery within the metropolitan area would disappear" and "the chance of agriculture's being profitable is small". This "will surprise many. Once abandoned, farmlands do not return to natural desert; policies will have to be adjusted to allow for slower growth over a longer time if efficient use of land and water resources is to become a reality".

Milliken presents Denver's similar problems, with a proposal for a major development project --- Two Forks Dam --- and its opposition by a group of "water system management reformers". "Tradition versus change and persistence versus reform are the water management issues facing Denver".

El-Ashry and Gibbons give a good introduction and summary chapter to this well-done overview of the present water problems facing water managers in the arid lands of the western United States.

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Hydrogeology edited by William Back, Joseph S. Rosenhein & Paul R. Seaber

Volume 0-2 of *The Geology of North America*, published 1988 as part of the Decade of North America Geology Series by the Geological Society of America Inc., 3300, Penrose Place, PO Box 9140, Boulder, Colorado 80301, USA; 524 + xi pp + 3 colour plates in pocket; price \$49.50; ISBN 0-8137-5206-x.

This is a large volume of 523 pages with three accompanying coloured maps. It describes the major features of North American regional hydrogeology and, importantly, contains a number of chapters describing the principles of hydrogeology and the significance of groundwater in a variety of geological processes. It is excellently presented and illustrated with contributions by a large number of internationally recognized groundwater scientists.

North America is defined as including Canada, the United States, Mexico and the West Indies. Introductory chapters cover the historical perspective, hydrostratigraphical units and the breakdown of the regional settings. These are followed by 28 chapters of descriptive hydrogeology for the defined regions. Each chapter is brief but apposite and well referenced. The regions have been grouped into sectors which are designated as Cordilleran, Central Cratonic, Appalachian, Coastal Plain, Island and Permafrost, and as such