

2009 MEDALS & AWARDS

O.E. MEINZER AWARD

Presented to **W. Mike Edmunds**



W. Mike Edmunds
Oxford Centre for Water Research

Citation by Alan E. Fryar

I am honored to introduce Mike Edmunds as the recipient of the 2009 O.E. Meinzer Award. During a career of more than four decades, Prof. Edmunds has made seminal contributions to multiple topics in groundwater chemistry. These include controls on water quality in regional aquifers, recharge over a variety of time and space scales, and the origin of mineral and thermal waters. His research exemplifies how combining scientific insight with technical innovation can yield an improved understanding of groundwater quality and availability.

Mike earned an Honours BSc in Geology (1964) and his PhD in geochemistry (1968), focusing on the genesis of garnet in polymetamorphic rocks, at the University of Liverpool. In 1966, he began a 35-year career at the British Geological Survey, where, to quote Willy Burgess of University College London, Mike became “the father of hydrogeochemistry in the UK”. His research initially encompassed chemical processes in aquifers in Great Britain, the impacts of acid rain on shallow groundwater quality, and, as noted by Yousif Kharaka of USGS, “some of the earliest investigations of geothermal resources,” particularly the chemistry of hot, dry-rock reservoirs. Subsequent studies in the Sahara and Sahel sparked Mike’s sustained interest in groundwater recharge

* Citation publications noted in bold.

and paleohydrology in semi-arid regions. Since the mid-1990s, he has coordinated several major projects sponsored by the European Commission, including baseline groundwater quality and paleohydrology of aquifers across Europe. He retired from an Individual Merit position at the BGS in 2001 but retains an appointment there as Honorary Research Associate. In 2002, Mike became Research Director of the Oxford Centre for Water Research. He holds the title of Visiting Professor of Hydrogeology in the Oxford University Centre for the Environment, where he coordinates the MSc program in Water Science, Policy, and Management.

Mike has been a remarkably prolific and influential researcher in hydrogeology. He has more than 140 externally peer-reviewed publications; according to Science Citation Index, at least nine of his papers have been cited more than 30 times each. He was a founder of the International Association of Geochemistry and Cosmochemistry’s Water-Rock Interaction Group, which he chaired from 1986 to 1997. His contributions have been recognized with the Ineson Lectureship (1998) and Whitaker Medal (1999) of the Geological Society of London, the Ingerson Lectureship (2004) of the IAGC, and lectureships at Trinity College Dublin, Oxford, and Waterloo. He has received the Meinzer Award for four publications that represent the depth, breadth, and sustained productivity of his research:

Edmunds, W.M., Bath, A.H., and Miles, D.L., 1982, Hydrochemical evolution of the East Midlands Triassic sandstone aquifer, England: *Geochimica et Cosmochimica Acta*, 46, 2069-2081;

Edmunds, W.M., and Walton, N.R.G., 1983, The Lincolnshire Limestone—Hydrogeochemical evolution over a ten-year period: *Journal of Hydrology*, 61, 201-211;

Cook, P.G., **Edmunds, W.M.**, and Gaye, C.B., 1992, Estimating paleorecharge and paleoclimate from unsaturated zone profiles: *Water Resources Research*, 28(10), 2721-2731;

Edmunds, W.M., and Milne, C.J. (eds.), 2001, Palaeowaters in Coastal Europe: evolution of groundwater since the late Pleistocene: Special Publication 189, Geological Society, London, 332 p.

Edmunds and others (1982) was among the first studies that integrated a broad suite of analyses (major and minor solutes, stable isotopes, ¹⁴C, and aquifer mineralogy) with geochemical modeling to delineate regional-scale processes of hydrochemical evolution in a clastic aquifer. **Edmunds and**

Walton (1983) complemented the 1982 paper by highlighting hydrochemical evolution in a regional carbonate aquifer and documenting how water quality changed in the upgradient part of the system as a result of agricultural inputs. This paper may have been the first to identify the potential significance of natural attenuation of contaminants (in this case, nitrate reduction) at the regional scale. As noted by Bridget Scanlon (University of Texas), Mike’s “use of major and trace element concentrations as indicators of redox sequence in an aquifer ... with age indicators and palaeo-recharge temperature proxies provided a sophisticated look at the relationships between water/rock interaction, climate and abstraction.”

Using numerical modeling, **Cook and others** (1992) demonstrated how chloride and stable-isotope profiles in the unsaturated zone can preserve sub-decadal to century-scale fluctuations in recharge. Yousif Kharaka commented that Mike “was the first to show how (vadose-zone) tracer based approaches may be used to resolve recharge rates and ... history. The results have had profound implications to recognizing the limits of renewable groundwater, especially in semi-arid regions.” Bridget Scanlon added, “Mike’s vadose zone chloride investigations introduced the hydrogeological community to one of its most valuable approaches to recharge estimation.... The approach has become an indispensable tool for recharge and palaeo-recharge studies worldwide and makes recharge assessment broadly accessible to developing countries and remote locations.”

Edmunds and Milne (2001) drew together studies demonstrating the emplacement of paleowaters in coastal aquifers across northern and western Europe. In addition to being the book’s senior editor, Mike authored or co-authored seven of its 17 papers. Yousif Kharaka highlighted Mike’s work as “instrumental in the recognition of off-shore palaeowaters as an important new water resource”. This volume is cited in a paper just published on-line in *Ground Water* by Cohen and others, “Origin and extent of fresh paleowaters on the Atlantic Continental Shelf, USA”.

Mike Edmunds’ output has been not only meticulous and prolific, but of great practical relevance. Perhaps more than any other hydrogeologic researcher of our era, he has worked in multiple regions, developed and developing, humid to arid, including Europe, north Africa, the Middle East, China, Siberia, and Mexico. In its diversity statement, GSA describes itself as “a global

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professional society". It is thus fitting that the Hydrogeology Division recognizes Prof. Mike Edmunds with the 2009 Meinzer Award.

Response by W. Mike Edmunds

First let me thank you, the GSA Hydrogeology Division and especially the Awards Committee in this Golden Jubilee year for your generosity in having nominated me for the prestigious O.E. Meinzer Award.

Secondly I owe special thanks to Alan for his eloquent citation and hard work involved for putting all this together and for the others who have been involved in the process.

Thirdly I would like to acknowledge the inspiration of many British hydrogeologists and working colleagues who have been part of my scientific career. I feel specially honoured as the first British recipient of this award and as a Fellow of your sister society — the Geological Society of London

Like many hydrogeologists I entered the subject from a hard rock background and was fired up wanting to work further on my electron probe studies of garnet in metamorphic rocks. Even as a hydrogeologist I continue to owe my scientific approach and discipline to the remarkable University of Liverpool where I studied in the "swinging sixties" inspired especially by Robert Shackleton, Wally Pitcher and Mike Atherton.

Hydrogeology was a Cinderella subject in UK in the 1960s and I am indebted to Stevenson Buchan and David Gray who offered me a job in the newly-formed Water Department at the British Geological Survey and who had faith in me to apply my geochemistry at lower temperatures. I joined on the same day as the new Director, Sir Kingsley Dunham. It was Sir Kingsley from his work on ore forming fluids, who was inspirational in getting me up to speed in this new subject.

I think it was his strong friendship with Don White and an early meeting with Don that introduced me to what was going on across the Atlantic. Armed with two books — the classic by John Hem and probably the best book on hydrogeochemistry ever written - Solutions, Minerals and Equilibria — by Bob Garrels and Charles Christ, I never looked back.

The first task was to set up new hydrogeochemical laboratories and take a fresh look at British aquifers and the geochemical processes controlling their water quality. The **first two citations** represent two of the papers from this period and exemplify the teamwork and productivity with colleagues of our small group (Adrian Bath, Doug Miles and Nick Walton) that enabled us to apply the growing range of chemical and isotopic tools to build our understanding of the British aquifers.

I would like to make special acknowledgement at this point of the encouragement offered by Bill Back (USGS) in my early career on carbonate aquifers. If I had accepted his offer to join him working on the Edwards Limestone my career might have taken a different course.

Sir Kingsley Dunham supported my application to attend the IAGC Symposium on Hydrogeochemistry and Biogeochemistry in Tokyo (1970) where I first presented the Lincolnshire work. In Tokyo I was present at the birth of the IAGC Working Group on Water-Rock Interaction. This coincidence had a strong influence on my career. I have kept the WRI faith for almost 40 years through the Water-Rock Interaction Symposia and have had the privilege of meeting and working with numerous inspirational hydrogeochemists — Tom Paces, Brian Hitchon, Yousif Kharaka — to mention just three.

One of my early assignments (1967–1974) was to be part of the BGS team exploring for groundwater in Libya. Apart from successfully defining the boundaries for the subsequent "Great Man Made River" this introduced me to a lifelong fascination with water in semi-arid regions and the amazing resilience of its peoples. Following our initial work in Cyprus, I had the opportunity to work in Sudan and then in other Arab countries and in the countries of the African Sahel investigating groundwater recharge and recharge history.

Here I would like to pay tribute to the inspiration of the late Jean-Charles Fontes, with whose collaboration I was able to join up the loose ends of our research in West Africa. The **third citation** comes from this period of my career where Peter Cook, this year's Darcy lecturer, and I were able to consolidate

some of the geochemical recharge studies which owe much of their success to Australian connections.

It has proved exciting and challenging in the past two decades to discover Europe, working with colleagues in many European countries (including Russia!), discovering new scientific and multidisciplinary avenues and enabling me to follow a less-insular approach. Working with large teams in Europe on geothermal energy, hydrogeochemical exploration, palaeohydrology, and baseline geochemistry has led to some highly rewarding research, lasting friendships, and not least an improvement in my linguistic skills - and an appreciation of good wine. The **fourth citation** exemplifies this work which provided an opportunity to apply a wide range of isotopic, geochemical knowledge working with Quaternary geoscientists to understand palaeo-groundwater evolution at a continental scale.

There have been many privileges and learning experiences in working with peoples in rural and often remote areas, hearing water stories first hand and appreciating the hardships still faced by the some of the world's poorest people. These experiences have inspired me and helped me to focus scientifically in key areas of water scarcity and stress on water quality. As hydrogeologists I think we are well placed to transfer good science to the needs of society. Working now with colleagues across a wide field in Oxford University has opened new opportunities for teaching and for integrating our science into areas of water policy and better management of our valuable groundwater resources.

It remains to propose one further special vote of thanks. I could not have sustained such a career were it not for the patience, love and support of my wife Kathy and the "family support team" (Katharine, David, Victoria and Paul), who have often joined me in the field.

It is with deep gratitude to the GSA and the Hydrogeology Division and a degree of humility that I am pleased to accept the 2009 OE Meinzer award. I wish the Division well for the next 50 years!