



Readers from  
**178 Countries**

Over **300,000 Free**  
**Book Downloads** and  
**735,000 Online Reads**

**1,000 Volunteers**  
from **70 Countries**

Translating Books  
into **54 Languages**

## *Progress and Expanded Vision*

The Groundwater Project (GW-Project) is pleased to announce two milestones: first, the preparation of an expanded vision and second, publication of its **50<sup>th</sup> book**, available online, free-of-charge. The **first book** was published in **August 2020**. With 30 books in our review process and 150 being prepared, our high-quality educational resources are expanding, an accomplishment made possible by our 1,000 volunteers (authors, reviewers, translators, collaborators) worldwide. We have seen rapidly expanding interest in our books with 100,000 downloads in the last 6 months, which previously occurred over 17 months. The GW-Project is a testament to flourishing global collaboration. Books are now being translated into 54 languages with 60 translations published and a further 175 underway. The GW-Project is working with partners globally to create innovative online course material. The eventual aim is to make available much or all that is needed for groundwater education at a university master's level. This will cover the knowledge relevant to hydrogeological understanding and is expanding from books to include production of short multi-media modules and other products including video short courses by book authors aimed at self-learning. Future books will include those at interfaces such as groundwater law, economics, human health and more.

## *Spring 2024*

PG. 2 – Synthesizing Groundwater Knowledge  
PG. 2 – Global Freshwater Crisis  
PG. 3 - The Expanded Vision for the Groundwater Project  
PG. 4 - Expanded Global Engagement  
PG. 6 - Partnerships and Collaborative Outreach  
PG. 6 - Outreach to Developing Countries  
PG. 7 - Book Categories  
PG. 8 - Sponsorship and Volunteer Engagement – We Need Your Support  
PG. 9 - Groundwater Project Sponsors  
PG. 10 - Groundwater Project Publications – First 50 and Translations  
PG. 12 - Groundwater Project Publications – Next 50  
PG. 13 - Groundwater Project: Preserved Books

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*Representatives from China, India and Australia to be added in 2024.*

**Staff:** Amanda Sills, Emily Horodezny.

## Synthesizing Groundwater Knowledge

The GW-Project is filling a gap created by the commercial publishing industry that operates nearly all scientific journals covering groundwater science and is the publisher of nearly all textbooks and monographs including water science. This publishing system plays an important role in advancing science through the well-established peer-review process that is rigorous and has served the scientific community with efficiency. Since scientific publications are typically not available for free, it does not serve the need for dissemination of research results to the user communities that serve society's needs. Furthermore, scientific journal papers are narrow in scope and are not translated, which limits usefulness for practical action globally.

Textbooks and monographs have the responsibility to synthesize material from scientific journals. However, these have become rare for groundwater topics due to minimal profit opportunities. Government organizations and professional associations that, decades ago, published books and reports of synthesized knowledge now publish less. So, publication outlets for synthesized groundwater science aimed at wide understanding and usefulness have faded away.

The GW-Project was created to publish synthesized science for many readerships and water stakeholders. With free-of-charge access and translations, the GW-Project is leading the way in democratizing learning about groundwater and its many interfaces with the environment and society. This is urgently needed for a sustainable future. This is urgently needed for a sustainable future. To that end, The GW-Project is an act of hope to meet the needs for building the human capacity for sustainable development and management of groundwater.

## Global Freshwater Crisis

There is a global freshwater crisis that threatens our food supply and societal stability. Groundwater is at the heart of the crisis because groundwater makes up 99% of all liquid freshwater and this becomes 100% in some regions when sustained drought occurs. According to UNESCO (2021)<sup>i</sup> groundwater issues are important impediments to achievement of all seventeen United Nations Sustainability Goals. The figure below summarizes key aspects of the freshwater crisis.

Hydrogeology is the key scientific discipline underpinning decisions about freshwater, but the profession is declining in developed countries and hardly exists in other countries. The decline includes diminishing numbers of well-educated hydrogeologists and the inadequacy of current educational programs to teach problem-solving skills relevant to complex groundwater regimes. Furthermore, the public and politicians at large are not well informed about groundwater and are unable to influence policy and legislation that takes groundwater into account.

The Groundwater Project aims to improve both groundwater sustainability and contribute to resilient groundwater systems. It is not enough to develop sustainable groundwater resources; it is important to design the supporting infrastructure with an eye toward how they might be challenged given continuing global warming, large catastrophic events, changing climatic patterns and increasing demand. The resilience of groundwater resources is essential to humanity's future.



Groundwater at the heart of the global water crisis

### Human Capacity is the Key Limitation to Progress

- Small number of groundwater professionals
- Lack of university groundwater programs with sufficient faculty to offer adequate scope of groundwater education
- Insufficient exposure to groundwater knowledge for policy and decision makers and the public.

In response to this, The GW-Project ([gw-project.org](http://gw-project.org)) was initiated in 2017 and is now well-recognized globally. The GW-Project publishes online books that synthesize groundwater knowledge—with translations—for free-of-charge downloading. Creation of the first fifty original, high-quality, books established the process of rigorous peer review and expanded use of original illustrations. However, hundreds more books are needed to cover all that is important for groundwater to be understood within the groundwater community and beyond this community to fully serve society.

Decision making about water resources is commonly flawed due to minimal understanding of groundwater beyond the expert groundwater community and due to gaps in research. Books are being developed on the interfaces of groundwater and ecosystems; groundwater and human health; groundwater and law/social sciences/governance; and on groundwater settings that, globally, serve many people but have minimal educational literature (e.g., mountains, deserts, islands, wetlands, fractured rock, and urban environments), including case studies. The GW-Project as a knowledge repository and its philanthropic volunteerism model provides value to both the developed and developing countries (e.g., countries with water poverty) by improving groundwater understanding through education for schools, the public, university students, hydrogeology professionals, and professionals in disciplines related to groundwater.

Many of the most knowledgeable and experienced hydrogeologists around the world are now in the late stage of their careers. The GW-Project has been successful in its quest to have many in this career stage prepare GW-Project books. This quest will continue and is important because this knowledge needs to be captured while it is still available.

## The Expanded Vision for the Groundwater Project

Hydrogeology became recognized as a scientific discipline in the 1950s with the establishment of the International Association of Hydrogeologists (IAH). Since then, hydrogeology has expanded greatly in its knowledge domains from encompassing only physical principles, mostly geology combined with fluid mechanics, to include hydrogeochemistry and isotopes, contamination including immiscible liquids, microbial



processes, and groundwater dependent ecosystems. Because of the multi- and trans-disciplinary nature of groundwater problems, solutions nearly always require multifaceted and integrative understanding of processes and concepts. This presents an exceptional challenge for education. Referring to the various specific knowledge domains as “dots” (e.g., hydraulics, flow systems, hydrogeochemistry, contamination, geophysics, etc.), the primary challenge in hydrogeologic problem solving is connecting dots—and connecting dots should be the focus of hydrogeology education. However, in its current form, hydrogeology education is devoted mostly to educating students about each of the dots, leaving little time for learning how to connect dots, which is where development of the critical thinking skills for problem solving is most important. Therefore, the GW-Project seeks to form partnerships to foster online self-learning, initially with emphasis on the dots, so that in-person education can focus more on critical thinking.

A new thrust in the GW-Project pertains to the creation of multimedia modules, each 3 to 6 minutes long, for student self-learning and self-testing, allowing instructor-led education to focus on critical thinking. Each module covers a small part of a groundwater knowledge domain, including a combination of sketches and figures, as well as photos/videos of laboratory experiments, field investigations, and computer simulations. Each module is directed at a basic question such as “what is ... groundwater ... the water table ... infiltration” that builds from basic to rigorous understanding. Although other disciplines have created self-learning modules, their pedagogy is not well suited for the spatial thinking and conceptualization needs of hydrogeology. Ultimately, once we have excellent prototypes, the hundreds of modules needed for self-learning groundwater education can be created through the efforts of many global partnerships. This will take the knowledge contained in GW-Project books and make it actionable.

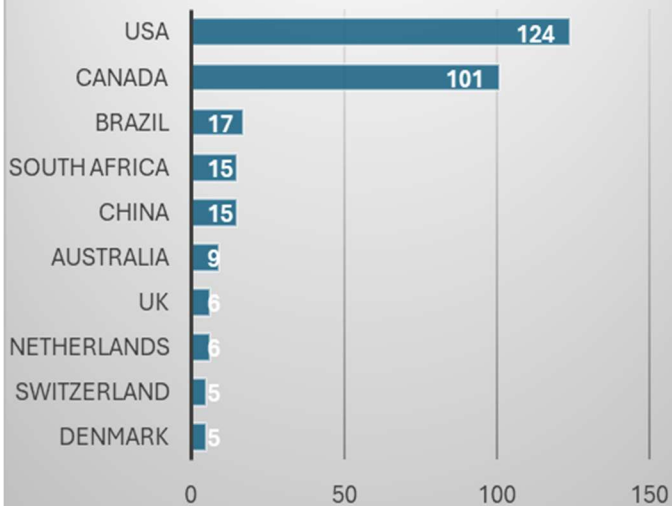
## Expanded Global Engagement

The GW-Project is expanding its global engagement, currently with 330 authors working in 23 countries, to many other countries over the next few years. At present, the largest group of authors are American and Canadian with significant representation by Emeritus Scientists from the United States Geological Survey. Brazil and South Africa have also had strong representation since inception. In 2023 and 2024, we have seen substantial growth in the number of authors joining the project from Europe, China, and Australia.

Many groundwater supply (and in certain cases contaminant) problems will require intermunicipal/inter-jurisdictional cooperation. The issues encountered vary globally due to the interconnections between climate, geology, terrain, groundwater flow, contaminant type, and geochemistry among other variables. As a result, it is important that GW-Project books incorporate case studies that cover a variety of global conditions. Case study books are being expanded to as many countries as possible to draw attention to exemplary accomplishments wherever they are found. We have a new path in which books will be created and published in a language other than English (e.g., Spanish) and later translated to and published in English followed by other languages.

The GW-Project has a global network of 450 volunteer translators, from 60 countries, covering 54 languages. The highest translation activity is in Spanish, followed by Portuguese translations (Brazil), then French, Arabic, Italian, Persian, German, Russian, Turkish and Vietnamese. Of note is the wide range of regional dialects currently being translated, including Amharic, Marathi, Pashto, Creole, Hausa, Igbo and others. We have seen an increase in book downloads in China, France, Germany, Iraq, Italy, Japan, Kazakhstan, Norway, Kenya, Rwanda, Senegal, and Spain. The GW-Project has become a world-wide recognized platform for groundwater learning.

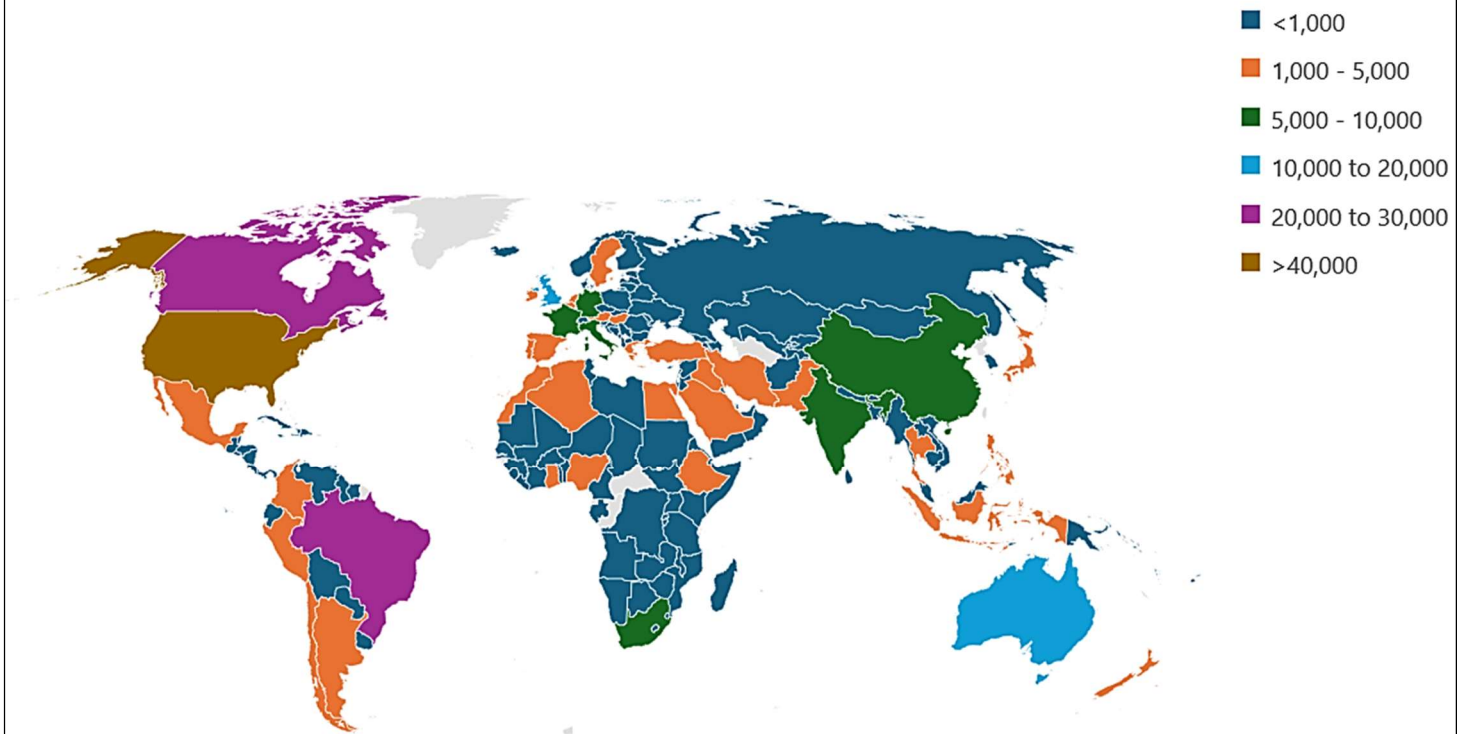
## Number of Authors by Top 10 Countries



## Number of Translators by Top 10 Countries



## Number of Book PDF Downloads by Country



## Partnerships and Collaborative Outreach

The core endeavor of the GW-Project continues to be the creation and publishing of books across a widening array of topics. This requires a continuous search for authors. Furthermore, in the effort to make knowledge actionable, we are forming partnerships and collaborations with diverse organizations. For example:

- ◆ Mercer University (USA): creation of prototypes of online learning modules; assessment of low-cost well drilling for developing countries.
- ◆ University of Waterloo (Can): integration of GW-Project books in a forthcoming 1-year master's program in hydrogeology to evolve into online learning.
- ◆ GroundwaterU (USA): creation and distribution of educational videos.
- ◆ Birmingham University (UK): determination of the essential hydrogeology knowledge which should be included in educational training based on its long established 1-year master's program.
- ◆ Fields Institute at the University of Toronto, Center for Sustainable Development (Can): integration of groundwater into sustainability thinking and creation of related books and courses.
- ◆ The Morwick G360 Groundwater Research Institute, University of Guelph (Can): exceptional expertise in monitoring system designs, rock water wells, and fractured bedrock contamination.
- ◆ NGWAU (USA): linkage with online training for global education of well drillers and for children's education.
- ◆ Oak Ridges Moraine Groundwater Program (Can): Collaborating to share knowledge of effective groundwater management and decision making.
- ◆ The Association of Polish Hydrogeologists - SHP (Poland): Partner to lead Polish translations and provide donations support to the GW-Project.
- ◆ The MetaMeta SMART Centre Group (Netherlands): training of the local private sector in Africa in manual and small-machine well drilling, locally produced hand and solar pumps, rainwater storage and harvesting, groundwater recharge and household water filters.
- ◆ Instituto Agua Sustentável (Brazil): promotion of the defense, preservation, and conservation of the water environment, as well as sustainable, economic, and social development.
- ◆ SYMPLE—a primarily online School of Hydrogeological Modelling (Italy): collaboration to blend theory with practice.
- ◆ IHE Delft—the primary water educational arm of the United Nations (Netherlands): collaboration on international education in Water and Sustainable Development.
- ◆ iNEX, an EU Erasmus+ project initiated by the universities of Barcelona (Spain), Dresden (Germany), Gothenburg (Sweden), and Graz (Austria), to develop and implement digital interactive, quantitative materials for groundwater education (open source).
- ◆ Luis Serrano Academy (Can): collaboration on enhancing learning through AI.

## Outreach to Developing Countries

The GW-Project has expanded its vision to put more effort into the production of groundwater learning materials for developing countries with emphasis on what is needed to alleviate rural water poverty. The aim is development of educational materials especially suitable for this need. It is widely recognized that, to alleviate rural water poverty, tens of millions of low-cost water wells are needed, especially wells that provide safe drinking water at the family and small farm scale. Another type of GW Project partnership involves the development and testing of new types of water-well drilling machines primarily of the type needed to combat rural water poverty and comparative testing of existing, low-cost, machines for manual and engine powered drilling.

But also essential is the understanding required to better select appropriate drilling locations and depths, and accomplish the installations, so that the result is a safe and sufficiently productive well. The primary deficiency associated with rural water poverty is insufficient understanding of groundwater occurrence and how to match drilling methods with local conditions. The GW-Project is teaming with individuals and organizations in this endeavor and is forming teams of hydrogeologists that link experts from developed countries with those in developing countries to foster interaction and gain understanding of country or region-specific problems and education needs. The first such team was formed in 2020 and involves 7 Central America countries (Panama, Honduras, El Salvador, Guatemala, Costa Rica, Nicaragua, Belize) which have similar terrain and groundwater problems.

Indigenous communities are often at the forefront of those experiencing worsening effects from a changing climate and subsequent effects on water supplies. In many global communities' women bear the burden of finding adequate water supply for their families. The Groundwater Project aims to provide resources to varying situations and circumstances that meet the need of the most vulnerable communities to build resilience.

## Book Categories

The books completed, in progress, and those envisioned in the future fit into 13 categories (Table 1), wherein each category pertains to the subject matter rather than the educational level or background of the intended reader. The exception to this categorization is Children's Books. After the first category of Children's books, the next category is foundational knowledge such as groundwater processes, principles, and concepts for granular, fractured and karst media, ranging from books that have almost no mathematics to those that are founded almost entirely on math, physics, and/or chemistry. Understanding the foundational materials to an appropriate degree provides the basis for reading books in the other categories. The methods, tools, and models specific to each category are presented within the category. To enhance most categories, we seek books about exemplary accomplishments around the world that are country or region specific and deserve global attention because they are examples of what can be done when financial and/or exceptional expertise is brought to bear on filling a need. For example, one book in progress describes what the City of Guelph in Canada, which is dependent on a fractured rock aquifer, has done to create an exemplary urban groundwater monitoring network using advanced methods. Another book in progress is about China's recent creation of a national groundwater monitoring network of immense proportions based on advanced hydrogeologic knowledge.



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**Table 1 – Groundwater Project Book Categories.**

<b>Children's Books</b>
<b>Processes, Principles, and Concepts Underpinning Groundwater Science and Engineering</b>
<b>Preparatory Learning for Groundwater Education (geology, mathematics, fluid mechanics, chemistry)</b>
<b>Groundwater Geochemistry and Groundwater in Environmental Geochemistry</b>
<b>Groundwater in Water Resources Development, Negative Impacts and Sustainability</b>
<b>Groundwater Interactions with Surface Water, Vegetation, and Ecological Systems</b>
<b>Groundwater Contamination, Remediation, and Quality Protection</b>
<b>Groundwater, Agriculture, and Food</b>
<b>Groundwater as a Factor in Energy, Mining, and Infrastructure</b>
<b>Groundwater Processes in Formation of Minerals, Rocks, Land Masses, and Landscape</b>
<b>Groundwater with Relevance to Human Health</b>
<b>Governance, Law, Economics, and Sociology</b>
<b>Groundwater in the Context of Global Issues (the Big Picture)</b>

In addition to publishing books created by the GW-Project we post books previously published—generally two decades or more ago—that have enduring value but have been forgotten or are out of print. Many more preserved books will be posted as we receive permission from publishers that hold the copyrights. We also post or link to public domain reports and monographs that we believe deserve attention and accessibility.

## **Sponsorship and Volunteer Engagement – We Need Your Support**

The GW-Project started out as an adventure into the unknown with a vision that gradually took form. Thanks to the strong engagement from around the world we are now positioned to consistently deliver high quality books and expand our vision to align production of books and related education materials with specific needs in groundwater education world-wide.

The GW-Project is not government funded so grass roots generosity of individuals and companies is critical to our success. The GW-Project is volunteer based in combination with a small and productive staff. We would like to encourage organizations and individuals who are benefiting from GW-Project books and others who believe in the concept to support us through financial contributions. Even small contributions become important when the number of contributors is large. Support is needed for our core operations, to keep up with the rate of book submissions, and our new initiatives such as the development of online groundwater education modules. Please donate ([gw-project.org/donate](http://gw-project.org/donate)) or become a sustaining sponsor. For our sponsorship program, please contact our Director of Operations Amanda Sills ([amandasills@gw-project.org](mailto:amandasills@gw-project.org)). Donations are tax deductible in Canada and the USA.

We also need more volunteers beyond those who write and translate books to help with editing, outreach (e.g., country by country communications), fundraising, and the many other tasks that are arising as the GW-Project continuously expands (contact [amandasills@gw-project.org](mailto:amandasills@gw-project.org) for more information).



Groundwater Project Sponsors – Thank you for your support!



+ thank you to all individuals who made donations through our website.

## Groundwater Project Publications – First 50 Books and Translations

1. Groundwater in the Water Cycle: Getting to Know the Earth's Most Important Freshwater Source: E. Poeter, Y. Fan Reinfelder, J. Cherry, W. Wood, Doug Mackay (August 21, 2020) (Translations Published: Catalan, Italian & Turkish; Translations in Progress: Arabic, Portuguese, Polish, German, French, Marathi, Kurdish, Indonesian, Laos, Pashto, Kinyarwanda, Chinese)
2. Hydrologic Properties of Earth Materials and Principles of Groundwater Flow: B. Woessner, E. Poeter (August 21, 2020) (Translations in Progress: French, Greek, Hindi, Persian, Portuguese, Russian, Spanish, Telugu & Turkish)
3. Graphical Construction of Groundwater Flow Nets: E. Poeter, P. Hsieh (August 21, 2020) (Translations Published: Spanish; Translations in Progress: Portuguese & Italian)
4. Groundwater-Surface Water Exchange: B. Woessner (October 4, 2020) (Translations Published: Portuguese; Translations in Progress: Afrikaans, Arabic, French, German, Greek, Indonesia, Korean, Kurdish, Laos, Mandarin, Marathi, Otjiherero, Pashto, Spanish, Turkish)
5. Conceptual and Visual Understanding of Hydraulic Head and Groundwater Flow: A. Cohen, J. Cherry (October 19, 2020) (Translations Published: Bahasa Indonesia, Farsi & Portuguese; Translations in Progress: Bengali, Catalan, French, Italian, Spanish, Turkish & Vietnamese)
6. Groundwater Resources Development: Effects and Sustainability: L. Konikow, J. Bredehoeft (October 27, 2020) (Translations Published: Spanish; Translations in Progress: Portuguese, Malay, Urdu, Arabic, French, Persian & Chinese)
7. Introduction to Isotopes and Environmental Tracers as Indicators of Groundwater Flow: P. Cook (November 3, 2020) (Translations Published: Greek; Translations in Progress: Italian, Portuguese, Arabic, Spanish & French)
8. Groundwater Storage in Confined Aquifers: H. Wang (November 10, 2020) (Translations Published: Arabic, Persian, Italian, Portuguese & Spanish)
9. Geologic Frameworks for Groundwater Flow Models: JP Brandenburg (November 17, 2020) (Translations Published: Arabic, French, Hungarian, Italian, Portuguese & Spanish; Translations in Progress: Amheric & Hausa)
10. Groundwater Velocity: R. Devlin (December 1, 2020) (Translations Published: Spanish & Greek; Translations in Progress: French, Italian, Portuguese & Polish)
11. Children's Book: Wally and Deanna's Groundwater Adventures...: L. Appleby, P. Russell, F. Restagno (2020) (Translations Published: Afrikaans, Arabic, Chinese, Creole, Finnish, French, Galician, German, Greek, Hausa, Hindi, Hungarian, Indonesian, Italian, Japanese, Malay,
21. Domestic Wells, Introduction and Overview: J. Drage (March 3, 2022) (Translations in Progress: French, Lingala Portuguese & Spanish)
22. Water Well Record Databases and Their Uses: G. Kennedy (March 3, 2022) (Translations Published: Italian; Translations in Progress: Spanish & French)
23. Introduction to Karst: E. Kuniansky, C.J. Taylor, J. H. Williams, F. Paillet (May 6, 2022) (Translations in Progress: Spanish, Indonesian, Chinese & Swahili)
24. Variable-Density Groundwater Flow: V.E.A. Post, C.T. Simmons (June 2, 2022) (Translations in Progress: Spanish)
25. Large Aquifer Systems Around the World: J. van der Gun (July 17, 2022) (Translations in Progress: Spanish & French)
26. Distributed Fiber-Optic Hydrogeophysics: S.W. Tyler, J.S. Selker, N. van de Giesen, T. Bogaard, J. Aguilar-López (July 17, 2022) (Translations in Progress: Spanish)
27. Children's Book: Claire and the Invisible Water: L. Cordeiro de Souza, M. Ribeiro (August 9, 2022) (Translations Published: Malayalam; Translations in Progress: Spanish & Turkish)
28. Dissolved Organic Carbon in Groundwater Systems: F. Chapelle (August 29, 2022) (Translations Published: Spanish; Translations in Progress: Vietnamese)
29. The Edwards Aquifer: J. Sharp, R. Green (September 11, 2022) (Translations in Progress: Spanish)
30. Stable Isotope Hydrology: R. Diamond (December 8, 2022) (Translations in Progress: Portuguese, Spanish & Vietnamese)
31. Fractures and Faults in Sandstone and Sandstone-Shale/Mudstone Sequences and Their Impact on Groundwater: A. Aydin, R. Ahmadov, M. Antonellini, J. Cherry, A. Cilona, E. Flodin, G. de Joussineau, B. Parker, J. Zhong (January 2023) (Translations in Progress: Spanish & French)
32. Groundwater in Peat and Peatlands: J. Price, C. McCarter, B. Quinton (February 2023) (Translations Published: Spanish)
33. Structural Geology Applied to Fractured Aquifer Characterization - Amélia João Fernandes, Alain Rouleau, Eurípedes do Amaral Vargas Junior (April 2023) (Translations in Progress: Spanish)
34. Groundwater Quality and Examples of Risk Procedures: E. McBean (June 2023) (Translations Published: Chinese; Translations in Progress: Spanish & French)
35. Groundwater and Hydrothermal Ore Deposits: M. Appold and G. Garven (July 2023) (Translations in Progress: Spanish)
36. Colloid (Nano- and Micro-Particle) Transport and Surface Interaction in Groundwater: W. Johnson, E. Pazmino (August 2023) (Translations in Progress: Spanish)

- Mongolian, Portuguese, Setswana, Spanish, Swedish, Urdu, Yoruba; Translations in Progress: Amharic, Basque, Bengali, Catalan, Dutch, Malayalam, Marathi, Quechua, Swahili, Tagalog & Tshivenda)*
12. Hydrogeology and Mineral Resource Development: L. Smith (March 24, 2021) (*Translations in Progress: French, Portuguese, Russian & Spanish*)
  13. Septic System Plumes as Examples of Transport and Fate: W. Robertson (May 11, 2021) (*Translations Published: Arabic, Persian, Portuguese & Vietnamese; Translations in Progress: French, Mongolian, Spanish & Thai*)
  14. Flux Equations for Gas Diffusion in Porous Media: D. McWhorter (July 28, 2021) (*Translations in Progress: German, Portuguese & Spanish*)
  15. Land Subsidence and its Mitigation: G. Gambolatti, P. Teatini (August 11, 2021) (*Translations in Progress: Arabic, Persian/Farsi & Spanish*)
  16. Managed Aquifer Recharge: Southern Africa: B. Eberhard and S. Israel (July 23, 2021) (*Translations in Progress: French, Portuguese & Spanish*)
  17. Groundwater Microbiology: G. Ferris, N. Szponar, B. Edward (September 28, 2021) (*Translations Published: Portuguese; Translations in Progress: Chinese & Spanish*)
  18. A Conceptual Overview of Surface and Near-Surface Brines and Evaporite Minerals: W. Wood (December 14, 2021) (*Translations in Progress: Arabic, Portuguese & Spanish*)
  19. Fluoride in Groundwater: K. Nordstrom, P. Smedley (December 22, 2021) (*Translations in Progress: Igbo & Spanish*)
  20. Electrical Imaging for Hydrogeology: K. Singha, F. Day-Lewis, T. Johnson, L. Slater (December 14, 2021) (*Translations Published: Spanish; Translations in Progress: Greek & Persian/Farsi*)
  37. Groundwater and Petroleum: Y. Kharaka, B. Hitchon, J. Hanor (August 2023) (*Translations in Progress: Chinese, Russian & Portuguese*)
  38. Urban Groundwater: K. Howard (September 2023) (*Translations in Progress: Persian, Portuguese, Spanish & Chinese*)
  39. An Introduction to Hydraulic Testing in Hydrogeology: Basic Pumping, Slug, and Packer Methods: W. Woessner, A.C. Stringer, and E. Poeter (September 2023) (*Translations in Progress: Spanish*)
  40. Hydrogeology Glossary: J. Sharp (October 2023) (*Translations in Progress: French & Spanish*)
  41. Geophysical Logging for Hydrogeology: J. Williams and F. Paillet (November 2023)
  42. Getting Started with MODFLOW: R. Winston (November 2023) (*Translations in Progress: French*)
  43. Introduction to the Mechanics of Flow and Transport for Groundwater Scientists: H. Klammler (November 2023)
  44. Biotic Transformations: B. Rittman (Published December 2023)
  45. History and Hydraulics of Flowing Wells: J. Xiaowei, J. Cherry (Published January 2024)
  46. Characterizing Legal Implications of Transboundary Aquifers: G. Eckstein (Published January 2024) (*Translations in Progress: Portuguese*)
  47. Age Dating Young Groundwater: K. Solomon, T. Gilmore (Published February 2024) (*Translations in Progress: French*)
  48. Elmvale Groundwater Observatory: B. Shotyk et al. (March 2024)
  49. Darcy's Law in Variable Density Groundwater Systems: F. Marinelli (May 2024)
  50. Properties of Organic Contaminants: D. Mackay, R. Allen-King, W. Rixey (May 2024)



## Groundwater Project Publications – Next 50

1. Karst: Environment and Management of Aquifers: Z. Stevanovic, J. Gunn, N. Goldscheider, N. Ravbar
2. Flow and Distribution of Non-aqueous Phase Liquids: K. Mumford, B. Kueper, R. Lenhard
3. Conjunctive Water Management: R. Evans, R. Hanson
4. Identifying International Legal Trends for Managing Transboundary Groundwater Resources: G. Eckstein
5. Prediction of Groundwater Sustainability and Land Subsidence in the Toluca Aquifer System, Mexico: J. Garfias Soliz, R. Martel, A. Calderhead, P. Castellazzi
6. Sobreexplotación y Sustentabilidad del Agua Subterránea en el Acuífero del Valle de Toluca: J. Garfias Soliz, L. Bibiano Cruz, R. Martel, D. Rudolph
7. Hidrogeología y recursos de agua subterránea en formaciones e islas volcánicas: HIRAVOL (Hydrogeology and groundwater resources in volcanic formations and islands): E. Custodio
8. Transboundary Groundwater Management in the Mackenzie River Basin, Canada: R. Pentland
9. Introduction to Groundwater and Aquifers: I. Kalwij, J. Cherry
10. Hydrogeology of the Pannonian Basin: I. Almasi and J. Szanyi
11. Tracers of Recharge (Chlorine and Isotopes): P. Cook and P. Brunner
12. Using Groundwater Head Maps: L. Toran
13. Monitoring Requirements for Unbiased Visualization of Groundwater Data: D. Larssen, B. Black, F. Patton
14. Hydrogeochemistry: The Origin and Evolution of Geogenic Groundwater Solutes, a Journey of Discovery: W. Wood
15. Groundwater Pollution by Landfills: F. Lee, A. Jones-Lee
16. Basic Hydrogeology: An Introduction to the Fundamentals of Groundwater Science: M. Ulliana
17. Public Health Risk Assessment and Risk Management for Groundwater to Ensure a Safe Drinking Water Supply: S. Hrudey
18. Practical Groundwater Tracing with Fluorescent Dyes: T. Aley, T. Osorno, R. Devlin
19. Hydrogeology of the Oak Ridges Moraine Aquifer System, South-Central, Ontario, Canada: R. Gerber, D. Sharpe, S. Holysh, M. Marchildon, M. Doughty, S. Frape, L. Labelle, B. Smith, S. Shikaze
20. Conceptual Hydrogeological Models: F. Baechler
21. Groundwater Governance: K. Pietersen
22. Student Activities with Groundwater Flow: D. Lee
23. Catastrophic Recharging of a Dormant Aquifer Following an Infrastructure Failure: R. Newbury
24. Groundwater Need and Land Subsidence in the Beijing Plain: A Problem Still Ongoing: L. Zhu, P. Teatini, H. Gong, L. Guo, Y. Luo
25. Living with Karst: L. VanRooy and M. Dippenaar
26. Groundwater Contamination and Geoenvironmental Impacts of Upstream Oil and Gas Production: R. Jackson, R. Walsh, M. Dusseault, M. Kang
27. Multilevel Groundwater Characterization & Monitoring with the Westbay System: B. Black, D. Larssen, F. Patton
28. Vadose Zone: G. Parkin
29. Groundwater and Bottled Water: J. Weaver, P. Lachassagne and others
30. Hydrogeology and Geochemistry of Bottled Spring Waters in the United States: F. Chapelle
31. Capture of Groundwater by Wells: J. L. Wilson
32. Introduction to Modeling: B. Woessner, E. Kuniansky, E. Poeter
33. Interpretation of Pumping Tests and Other Indicators of Aquifer-Aquitard System Properties: G. van der Kamp, C. Neville
34. The Theory of Slug Tests: C. Neville
35. Domestic Well Basics for the Well Owner: H. Simpson, S. Longboat, H. Murphy, J. Levison
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<sup>i</sup> UNESCO (2021). The Role of Sound Groundwater Resources Management and Governance to Achieve Water Security (GWSI Series-No. 3, UNESCO Publishing, Paris, 279 pages.

