

Environmental Earth Sciences

Werner Balderer
Adam Porowski
Hussein Idris
James W. LaMoreaux *Editors*

Thermal and Mineral Waters

Origin, Properties and Applications

 Springer

Environmental Earth Sciences

Series editor

James W. LaMoreaux, Tuscaloosa, USA

For further volumes:

<http://www.springer.com/series/8394>

Werner Balderer · Adam Porowski
Hussein Idris · James W. LaMoreaux
Editors

Thermal and Mineral Waters

Origin, Properties and Applications

 Springer

Editors

Werner Balderer
Department of Earth Sciences
Schweizerische Geotechnische
Kommission
Zürich
Switzerland

Adam Porowski
Warszawa
Poland

Hussein Idris
Cairo
Egypt

James W. LaMoreaux
PELA GeoEnvironmental, Inc.
Tuscaloosa, AL
USA

H. Idris is deceased

ISBN 978-3-642-28823-4 ISBN 978-3-642-28824-1 (eBook)
DOI 10.1007/978-3-642-28824-1
Springer Heidelberg New York Dordrecht London

Library of Congress Control Number: 2014934304

© Springer-Verlag Berlin Heidelberg 2014

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed. Exempted from this legal reservation are brief excerpts in connection with reviews or scholarly analysis or material supplied specifically for the purpose of being entered and executed on a computer system, for exclusive use by the purchaser of the work. Duplication of this publication or parts thereof is permitted only under the provisions of the Copyright Law of the Publisher's location, in its current version, and permission for use must always be obtained from Springer. Permissions for use may be obtained through RightsLink at the Copyright Clearance Center. Violations are liable to prosecution under the respective Copyright Law. The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

While the advice and information in this book are believed to be true and accurate at the date of publication, neither the authors nor the editors nor the publisher can accept any legal responsibility for any errors or omissions that may be made. The publisher makes no warranty, express or implied, with respect to the material contained herein.

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

*Dedication of this volume of contributions
from the CMTW 2009 Egyptian Meeting
(October 10–18, 2009)*

*To the memory of Eng. Hussein Idris, Vice
Chairman of CMTW*

*Almost from the beginning of the Interna-
tional Association of Hydrogeologists (IAH)
Commission on Mineral and Thermal Water
(CMTW) in 1968 Eng. Hussein Idris was a
very active member of the Commission*

*Under his leadership, two great meetings
were held in Egypt in 2004 and 2009. The
2009 meeting was organized as a Special
Session to review 60 years of Eng. Idris’
professional activity in groundwater explo-
ration, engineering, and management*

*The theme of the 2009 CMTW meeting was:
Groundwater, Thermal and Mineral Water in
Areas of Arid conditions: Consequences for
the Current Situation of Climate Change and
the Increasing Population of Egypt. The
following topics were examined:*

Upcoming of saline waters in urban areas

Hydrogeology of the Sinai Desert

*Possibilities for the use of hot waters in
desert areas as sources of energy*

*Future development of oil fields: use of
oilfield waters for balneological purposes*

and as a source of raw minerals (as trace elements) and organic materials

There were also contributions by members of the CMTW and of Egyptian scientists related to other topics. During the meeting, tours focused on the following aspects of Egypt's geology:

Tour 1: Trip to historical sites of Cairo: Coptic Monastery, First Coptic churches in Cairo, first Mosque and first Synagogue, Sadat Memorial and outlook to Citadelle

Tour 2: Trip from Cairo to the Sinai desert related to the hydrogeology of arid areas and the utilization of hot waters in the desert; a visit to hot water well Nr. 20; the thermal spring of Bath of Pharaoh (Hammam Farun); and the Monastery of St. Catherine

Tour 3: Groundwater problems around Cairo: The upconing of saline groundwater emerging in surficial ponds as environmental threats to the fast growing city

Tour 4: Groundwater and petroleum production: visits to Qarun Oilfield and the Baharia Oasis, with its deep groundwater wells in the Nubian Sandstone

The two meetings of 2004 and 2009 were unforgettable as is the memory of Eng. Idris, a wise man, engineer, and practitioner in hydrogeology. He oversaw the installation of more than 100 deep groundwater wells in Egypt and Libya. He was not only a great geologist, but he was also a great personality, who served Egypt as a Colonel during the Sinai wars and as a diplomatic arbiter in an international conflict between Sudan and Yugoslavia in the 1970s

Eng. Idris served as Deputy Chairman and Joint Managing Director of Algulf, Ltd. of

Cairo, Egypt, and London, England. He was a consultant on short-term assignments in the Sudan for the Food and Agriculture Organization (FAO) of the United Nations and for the Arab Agricultural Development Organization of the Arab League. Previously he served as Chairman of the Land Reclamation and Agricultural Development Authority, was President of The General Company for Research and Ground Water (REGWA, the only Egyptian company specializing in research and groundwater). Throughout his career, he worked for the Egyptian government in various capacities. As Resident Irrigation Engineer of the Ministry of Public Works, he was responsible for the groundwater development in the Sinai, and Kharga and Dakhla Oases where he authorized well drilling and supervised a detailed hydrogeologic study

This unforgettable man died on January 2, 2013, but his memory will live on in the history of the CMTW, as demonstrated by the following publication: “Western Desert of Egypt: Genie of the Desert.” Genie of the Desert was Eng. Idris’ nickname and it was appropriate because he knew the desert like the back of his hand. Eng. Idris also prepared the “Annotated Bibliography on Mineral and Thermal Waters.” The bibliography, with about 1,500 references, stands as a major achievement of the CMTW

Eng. Idris was well respected by his peers as shown in a few of their remarks below:

*“He was dear, concerned, caring, and had an active, modern mind and thoughts”—
Magda Idris;*

“One of the most respected members, pillar of annual meetings, wise voice”—Adam Porowski;

“Open dialogue and common benefits; contributed to success and viability of the Commission”—Peter Kralj;

“Through these unforgettable excursions Idris helped us discover and fall in love with his wonderful country”—Natalia Vinograd;

“Often his remarks were combined with a wink of fine humor; and even though his body was weak in later years, there was a young mind open to everyone with a lot of life’s experiences grown on the soil of esprit”—Kurt Von Storch;

“He and my father (Dr. Philip LaMoreaux) began working together in the Western Desert of Egypt in the 1950s. He was like a second father to me over the years and he certainly served a similar role for all of us and the CMTW. He will be sorely missed”—Jim LaMoreaux



Organization Committee

Organizers

- The Arab Mining and Petroleum Association (AMPA)
- Egyptian National Committee of the International Association of Hydrogeologists (IAH)
- Egyptian Society of Engineers
- General Company for Research and Groundwater “REGWA”

Organizing and Scientific Committee

Shawki Abdin	Petroleum Geologist, member of the IAH Commission on Mineral and Thermal Waters (CMTW), member of the American Association of Petroleum Geologists (AAPG), board member of the Geological Society of Egypt and Arab Mining and Petroleum Association (AMPA)
Ismail Moftah	Engineer, member of the IAH, member of the AMPA, member of Society of Petroleum (SP), member of the American Chamber of Commerce, and Chairman of Engineering Consultancy Office for Oil and Gas in Egypt
Magda Idris	Hydrogeologist, member of the IAH, member of the AMPA
Ahmed M. R. Khater	Professor, member of the IAH, Director of Research Institute for Groundwater (RIGW)
Abd El Meguid Amer	Professor, Faculty of Engineering Azhar University, member of the AMPA, member of the Management Engineering Society, member of the Egyptian Engineering Society, member of the Association of Egyptians Graduated from German Speaking Institutions
Mohamed El Wagih	Professor, Head of The Mining and Petroleum Engineering Department Cairo University, member of the AMPA, member of the Egyptian Engineering Society

Ibrahim Zahran	Petroleum geologist
Hussein Idris	(Deceased) Hydrogeologist, Deputy Chairman of the IAH CMTW, member of the AMPA
Dr. Jim LaMoreaux	Chairman of the IAH CMTW, Chairman of PELA GeoEnvironment, Inc.
Dr. Adam Porowski	Hydrogeologist, Secretary of the IAH CMTW, Hydrogeologist at the Institute of Geological Sciences Polish Academy of Sciences
Dr. Werner Balderer	Hydrogeologist, Deputy Chairman of the IAH CMTW, Department of Earth Sciences of ETH Zurich, member of the Swiss Geotechnical Commission (SGTK)

Contents

Saline Groundwater Ascension Problems in East Cairo: Environmental Threats of Fast Growing Cities	1
Aly Werwer, Hamed Shaker and Magda Idris	
Origin, Anthropogenic and Climate Influences on the Occurrences of Saline Groundwater at the City of Cairo, Egypt Deduced by Chemical Parameters of the Water Composition	9
Werner Balderer, Fanny Leuenberger and Hussein Idris	
Sinai Peninsula: An Overview of Geology and Thermal Groundwater Potentialities	25
Mohamed Ragaie El Tahlawi	
Enhanced Fluoride in Groundwater in Eastern Anatolia: Effects, Origin and Possibilities for Remediation	39
Werner Balderer, Fanny Leuenberger, Giorgio Menghini and Walter Dierauer	
Origin of Thermal Waters in Budapest Based on Chemical and Isotope Investigations Including Chlorine-36	49
Werner Balderer, H. Arno Synal, J. Deák, I. Fórizs and Fanny Leuenberger	
Resources of Curative Mud of the Crimea Peninsula	61
Elena Kayukova	
Chemical and Isotopic Characteristics of Thermal Waters in the Carpathian Region, South Poland: Implication to the Origin and Resources	73
Adam Porowski	
Helwan Springs	91
Ibrahim El Shamy	

**Occurrence of High Bicarbonate Groundwater
in Victoria, Australia. 97**
Andrew Shugg

Industrially Valuable Components in Oilfield Waters of Russia. 111
Arkady Voronov and Natalia Vinograd

**Appendix A: Geographic and Geologic Terms
Connected With Egypt 119**

Appendix B: Photo Captions 123

Introduction

This special volume contains selected papers from the 38th Meeting of the Commission on Mineral and Thermal Waters of the International Association of Hydrogeologists (IAH-CMTW) held in Cairo, Egypt, on 10–18 October 2009. The meeting was organized by Engineer Dr. Hussein Idris, Deputy Chairman of the Commission, with the support of the Egyptian Chamber of Engineers and the Petroleum Society of Egypt. During scientific sessions at the meeting, several lectures were presented by members of the Commission as well as invited lecturers, local authorities, academic staff, and management staff from the petroleum and mining industry.

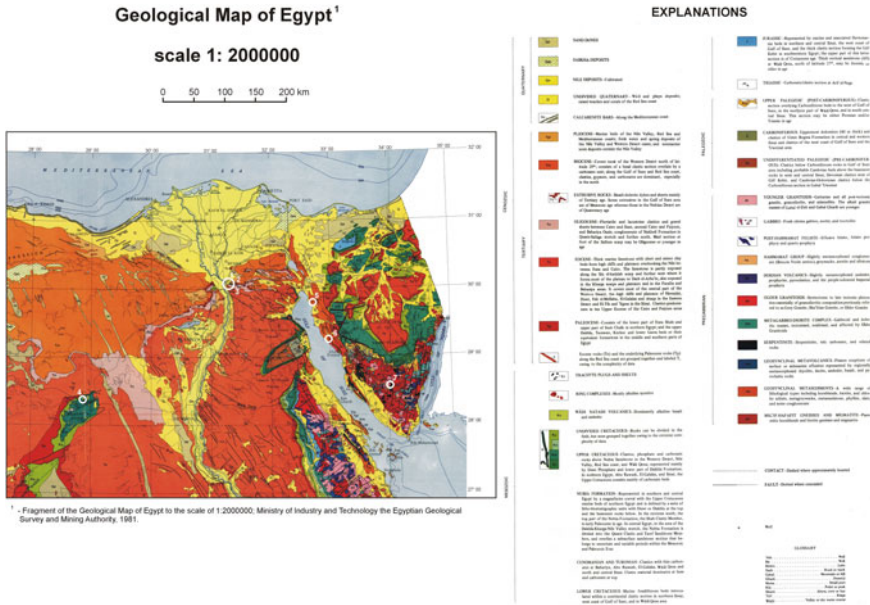
Some of the most interesting lectures are presented herein to demonstrate the variety of mineral and thermal waters occurrence and utilization in different countries of the world. Four papers concern mineral and thermal waters of Egypt. A detailed overview of the geology and thermal water potential of the Sinai Peninsula is given by Mohamed Ragaie El Tahlawi, Professor from the Mining and Metallurgy Department, Assiut University. His paper focuses on manifestations of thermal waters of outflow temperature between 35 and 72 °C at famous areas such as Oyun Mousa, Ras Sidr, Hammam Pharaun, and Hammam Mousa. Ibrahim El Shamy, Professor from the Hydrogeology Department, Helwan University, presents an interesting compilation concerning the mineral and thermal water springs in Helwan district. The important and urgent problems of pollution and mineralized groundwater ascension in the karstic area of southeastern Cairo of El Emmam El Shaffei district is presented by engineers of the REGWA Co., namely Aly Werwer, Hamed Shaker, and Magda Idris. Their presentation focuses on three old springs: Ain Al Sira, Khayalat Al Shorta, and Abo Al Saud, which are used to form big ponds in the city. Since the pond of Abo Al Saud spring was filled up with rocks and wastes and replaced finally by a garden, the water level started to rise in the remaining ponds. Nowadays the water level is dramatically high and frequently causes flooding in the adjacent district of Cairo. The team of Werner Balderer, in collaboration with Hussein Idris, made additional research concerning the origin of waters of these ponds. It appears that the waters are outflows of the outcropping Tertiary rocks in close vicinity, as well as outflows of outcropping Eocene formations of the East banks of the river Nile. Dr. Balderer and colleagues from Switzerland present another significant problem of high fluoride concentrations in drinking groundwater in several villages of Dogubeyazit area, Eastern



Fig. 1 Main point of interest of the field trip during CMTW IAH meeting in Cairo, 2009. 1, Ain Al Sira, Cairo; 2, Khayalat Al Shorta, Cairo; 3, Helwan district; 4, Baharia Oasis; 5, Ayun Mousa; 6, Hammam Faraun; 7, Mount Sinai. Map prepared based on Google Earth data

Anatolia, Turkey. Hydrogeological and hydrochemical investigations performed in the spring of 2002 revealed fluoride concentration in drinking water well above the WHO recommended limit of 1 ppm. Moreover, in three villages the fluoride concentration in drinking water was found in the range of 6–8 ppm, causing severe dental and health problems for the local population. This study discusses alleviating the problem by the following: (i) survey of the existing situation with regard to the current use of groundwater provided by the existing springs and boreholes, (ii) proposal of a new distribution network of groundwater resources with low fluoride concentration to improve the health and quality of life of the affected population.

Another interesting and cutting-edge study is presented by a team of CMTW members, i.e., József Deák and István Fórizs of the Institute for Geological and Geochemical Research of the Hungarian Academy of Sciences, Hungary, Werner Balderer, and coworker Fanny Leuenberger from Eidgenössische Technische Hochschule (ETH), Zurich. This study concerns the application of ^{36}Cl chlorine isotopes to investigate the origin of thermal waters in the area of Budapest, Hungary. Based on the ^{36}Cl isotopes the thermal waters extracted from springs and wells in Budapest are shown to have two components of meteoric origin. One component is connected with the modern hydrological cycle and contains tritium and ^{36}Cl typical for anthropogenic origin. The second component, the high temperature one, is the deep circulating ancient meteoric water with no tritium and $^{36}\text{Cl}/\text{Cl}_{\text{total}}$ ratio, indicating a very long transit time of groundwater or mixing of such an old component along the flow regime.



For the first time during the CMTW forum a contribution concerning the Crimea Peninsula, Ukraine, was presented. Elena Kayukova, Professor from the Faculty of Hydrogeology, University of St. Petersburg, Russia, provides a comprehensive description of the salt lakes in the Crimea Peninsula, their origin, chemical composition of waters, as well as chemical composition and curative features of the muds from these lakes. The muds formed in some lakes are treated as curative deposits and the resources are geologically recognized and documented.

Contributions from members of the Commission from Poland, Russia, and Australia are included. Adam Porowski, Professor from the Institute of Geological Sciences of Polish Academy of Sciences, Poland, presents a general overview of the chemical and isotopic characteristics of thermal waters in Carpathian Geothermal Province, Southern Poland. One of the phenomena in this region is the occurrence of the so-called dehydration waters, which are usually associated with oil and gas deposits. Natalia Vinograd, from the Faculty of Hydrogeology University of St. Petersburg, Russia, shows interesting and valuable research concerning the industrially valuable chemical components that can be recovered from oil field waters in Russia. Andrew Shugg from Sinclair Knight Merz, Melbourne, Australia, presents a very interesting comprehensive overview of high bicarbonate groundwater occurrence in the state of Victoria.

Hussein Idris organized the meeting and led an excellent field trip of the Western Desert. He passed away before this book was published. In his memory, it is dedicated to him and to all the lives he touched, particularly those of the CMTW members.