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Narasimman Sundararajan
Mehdi Eshagh • Hakim Saibi
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Editors

On Significant Applications of Geophysical Methods

Proceedings of the 1st Springer Conference
of the Arabian Journal of Geosciences
(CAJG-1), Tunisia 2018

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ISSN 2522-8714 ISSN 2522-8722 (electronic)
Advances in Science, Technology & Innovation
IEREK Interdisciplinary Series for Sustainable Development
ISBN 978-3-030-01655-5 ISBN 978-3-030-01656-2 (eBook)
<https://doi.org/10.1007/978-3-030-01656-2>

Library of Congress Control Number: 2018958942

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This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

Even with the advent and advancement of elegant tools and techniques coupled with sophisticated software and hardware, geophysical exploration for subsurface resources still poses a great challenge to the practicing geoscientists due to various known and unknown factors. The complex nature of geology, an improper choice of a geophysical tool or tools or even minute variations of physical properties between host rock and sources further complicate the problem of achieving the desired results. Therefore, geophysical exploration is a multifaceted task requiring a sound theoretical background with adequate field experience and a comprehensive knowledge of the geology of the area of study to yield reliable results. Further, all geophysical data are invariably corrupted with a wide variety of noise factors that complicate the interpretation. Therefore, data processing with appropriate mathematical and statistical tools that frees the noise from the acquired data is a major task. Interpretation of noise-free data with a correct choice of techniques ensures useable results in almost all geo-investigations.

This proceedings volume contains the best papers accepted for presentation during the 1st Springer Conference of the Arabian Journal of Geosciences (CAJG-1), Tunisia 2018. The book offers a variety of new case studies focused on mineral, groundwater, hydrocarbon, and environmental issues as well as a comprehensive study on recent earthquakes. In addition, there are significant studies on earthquake hazard assessment based on geophysical tools and techniques by experienced researchers mainly from research institutes or universities in the Mediterranean and Middle East region. The main topics include: Applications of gravity and magnetic methods, Electrical and Electromagnetic methods in mineral and groundwater exploration, Case studies on refraction and reflection seismic methods, Integrated geoscience applications in the exploration of subsurface resources, Hydrocarbon and petrophysical studies, Earthquakes and seismic hazard assessment and Tectonics. This volume gives new insights not only on the choice of particular geophysical methods in specific investigations but also about appropriate methods of analysis used to reach concise and concrete solutions and obtain desired results. In certain papers, the results of case studies are correlated with drilling data to substantiate the method of interpretation and its accuracy. Most of the studies presented here are from Mediterranean and Middle East and therefore, this volume will also provide an adequate understanding of the complexities of geology of this region, as well.

Muscat, Oman
Trollhättan, Sweden
Abu Dhabi, United Arab Emirates
Strasbourg, France
Jeddah, Saudi Arabia
Québec, Canada
July 2018

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Acknowledgements

Our appreciation is extended to the authors of the papers for their hard and diligent work in producing high-quality contributions. We would like to thank the reviewers of the papers for their in-depth reviews and great efforts in improving the quality of the papers. Also, thanks are extended to Amjad Kallel who supervised and handled the evaluation process, to Sahbi Moalla who handled the submission and evaluation system for the ten conference proceedings volumes, and to the publishing staff of Springer headed by Nabil Khélifi, Senior Editor for their efforts and contributions in completing this conference proceedings volume. All the above-mentioned efforts were very important in making this book a success.

About the 1st Springer Conference of the Arabian Journal of Geosciences (CAJG-1), Tunisia 2018



The *Arabian Journal of Geosciences (AJG)* is a Springer journal publishing original articles on the entire range of Earth sciences in partnership with the Saudi Society for Geosciences. The journal focuses on, but not limited to, research themes which have regional significance to the Middle East, the Euro-Mediterranean, Africa, and Asia. The journal receives on average 2000 submissions a year and accepts around 500 papers for publication in its 24 annual issues (acceptance rate 25%). It enjoys the participation of an editorial team of 100 international associate editors who generously help in evaluating and selecting the best papers.

In 2008, Prof. Abdullah Al-Amri, in close partnership with Springer, founded the Arabian Journal of Geosciences (AJGS). In this year, the journal celebrates its tenth anniversary. On this occasion and to mark this event, the Founder and Editor-in-Chief of the AJGS Prof. Al-Amri organized in close collaboration with Springer the 1st Conference of the Arabian Journal of Geosciences (1st CAJG) in Hammamet, Tunisia, from November 12 to 15, 2018 (www.cajg.org).

The conference was an occasion to endorse the journal's long-held reputation for bringing together leading authors from the Middle East, the Euro-Mediterranean, Africa, and Asia who work in the wide-ranging fields of Earth sciences. The conference covered all cross-cutting themes of Geosciences and focused principally on the following ten tracks:

- Track 1. Climate, paleoclimate and paleoenvironmental changes
- Track 2. Geoinformatics, remote sensing, geodesy
- Track 3. Geoenvironmental engineering, geomechanics and geotechnics, geohazards
- Track 4. Geography, geoecology, geoarcheology, geotourism
- Track 5. Geophysics, seismology
- Track 6. Hydrology, hydrogeology, hydrochemistry
- Track 7. Mineralogy, geochemistry, petrology and volcanology
- Track 8. Petroleum engineering and petroleum geochemistry
- Track 9. Sedimentology, stratigraphy, palaeontology, geomorphology, pedology
- Track 10. Structural/petroleum/mining geology, geodynamics, marine geology

The dynamic four-day conference provided more than 450 attendees with opportunities to share their latest unpublished findings and learn the newest geoscience studies. The event also allowed attendees to meet and discuss with the journal's editors and reviewers.

More than 950 short contributing papers to the conference were submitted by authors from more than 70 countries. After a pre-conference peer review process by more than 500 reviewers, 700 papers were accepted. These papers were published as chapters in the conference proceedings by Springer.

The conference proceedings consist of ten edited volumes, each edited by the following group of *Arabian Journal of Geosciences* (AJGS) editors and other guest editors:

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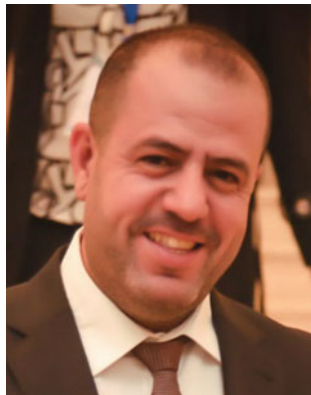
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About the Editors



Dr. Narasimman Sundararajan graduated in Mathematics from the University of Madras and then carried on with an M.Sc. (Tech) and Ph.D. in Exploration Geophysics from Osmania University, India. He began a career as a Research Scientist in the National Geophysical Research Institute under Council of Scientific & Industrial Research, Government of India and later switched over to teaching at the Centre of Exploration Geophysics, Osmania University, Hyderabad, India where he became a Professor in Geophysics in 2004. Presently, he is an Associate Professor of Geophysics in the Department of Earth Science, Sultan Qaboos University. He has published around 90 papers in the leading International journals and supervised several PhDs in Geophysics as well as Mathematics. He has published a book and a couple of book chapters during 2010–2012. He has implemented several research projects including Uranium exploration, earthquake hazard assessment studies, groundwater exploration, etc. He brought out a few innovative tools and techniques for the processing and interpretation of various geophysical data besides a mathematical equation called “*Sundararajan Transform*” (Exploration Geophysics, 2001) and a good deal of software including VLFPROS (Computers & Geosciences, 2007). He defined a valid and viable approach to multidimensional *Hartley transform* in contrast with the definition (Nature, 1991) of Prof. R. N. Bracewell, Stanford University, USA. Member of XIV Indian Scientific Expedition to Antarctica during 1994–1995 and carried out geophysical investigations, in which results were published in leading research Journals. Also, he was a member of IEEE transactions committee for the selection of best paper award in 2007. As a member of “Initiative for Research and Innovative in Science (IRIS)”, he motivated young students in India during 2003–2007 to get involved in scientific research. For his overall significant research contribution, Govt. of India has conferred upon him the *Mineral Award now known as National Award for Geosciences in 2007*. His research interests are varied and wide including geophysical data processing, mineral and groundwater exploration, earthquake hazard assessment studies, applied mathematics, bio signal processing, etc. Currently, he is an Associate Editor of “Arabian Journal of Geosciences (Springer)”, besides being a reviewer for many International Journals in multidisciplinary fields.



Dr. Mehdi Eshagh received his B.Sc. in Surveying Engineering 1999 from the Islamic Azad University, South of Teheran branch, M.Sc. in Geodesy 2002 from KNTU, University of Technology, and Ph.D. in Geodesy 2009 from Royal Institute of Technology (KTH) in Sweden. In October 2010, he was appointed as Docent/Associate Professor of Physical Geodesy/Space Geodesy at KTH and since September 2013 as professor of Geodesy at West University, Sweden. He has been a teacher of a variety of courses in Surveying Engineering at different levels of education from high school to Ph.D. programmes since 1999. His research interests include the fields of Physical Geodesy specially geoid and gravity field determination, satellite gravimetry and gradiometry, adjustment theory, satellite orbit determination, geodetic network optimization and design, theories of isostasy, Moho and density contrast determination, and sub-lithospheric stress modeling using gravimetric data. He has published and co-authored about 150 original articles, monographs, textbooks, edited books, special issues, and conference abstracts. He is the founder and senior managing editor of *Journal of Geodetic Science*. Also, he is cooperating as the editor of *Journal Numerical Methods in Civil Engineering*, *Geodynamics Research International Bulletin*, *Journal of Applied Engineering Sciences*, and *Journal of Geodesy and Geomatics Engineering*. In 2017, he joined the *AJGS* as an associate editor responsible for evaluating submissions in the fields of Geodesy and Solid Earth Geophysics.



Dr. Hakim Saibi holds a Ph.D. in Earth Sciences (2007) from Kyushu University (Japan). He is currently an Associate Professor at Geology Department, United Arab Emirates University (UAE). His research interests focus on exploration geophysics in general and developing new 2D and 3D geophysical codes for gravity and magnetic methods specially, 2D/3D Magnetotelluric for geothermal exploration, petroleum geosciences, hydrogeology & hydrochemistry, computational geosciences, volcanology, GIS, and remote sensing. He has developed new 2D and 3D methods for potential field data interpretation (modeling and inversion). He has published more than 46 International peer-reviewed journal papers, 65 proceedings in International Conferences, three books, and four book chapters. His publications covered 13 different countries from Asia, Africa, and Central America. He has supervised more than 10 M.Sc. and Ph.D. theses. In 2017, he joined the *AJGS* as an Assistant Editor supporting the Editor-in-Chief, and as an Associate Editor responsible for evaluating submissions in the fields of Geophysics. He is also Editor at *ASEAN Engineering Journal for Geological and Geo-Resource Engineering*.



Dr. Mustapha Meghraoui completed his Ph.D. (1988) at the University of Paris XI-Orsay (France) on Seismo-tectonics and Paleoseismology of the Tell Atlas in Algeria. He is a Senior Scientist at the “Institut de Physique du Globe” at the University of Strasbourg (France). His working group has achieved major strides, releasing pioneering studies on the identification of active faults in intra-plate Europe and inter-plate major continental active faults. They have developed paleoseismic studies in regions with fast active deformation and large earthquakes, and in regions with low-level seismicity in Europe. In particular, and for nearly 20 years now, the combination of micro-topography, shallow geophysics and trenching in active faulting studies has led the group to produce numerous peer-reviewed publications and internationally recognized research papers (ca. 90 articles in ISI-JCR journals, 2500 citations). These contributions focus on the development of paleoseismic and archeo-seismic studies and earthquake geology in different tectonic domains (North African Atlas, North and East Anatolian fault, and Dead Sea fault), and on the comparison between regions with slow active deformation and regions with fast seismic slip release. Furthermore, their research focuses on the development of a conceptual framework to deepen our understanding of long-term faulting behavior in earthquake-prone regions, and on studies of faults in regions with the potential for large or moderate earthquakes and related physical characteristics. He has contributed to many international scientific projects, supervised 12 Ph.D. theses, and coordinated several European and international (UNESCO) projects. He has served as an editorial board member for the *Annals of Geophysics* and *Natural Hazards* journals. He is currently an Associate Editor of the *Euro-Mediterranean Journal for Environmental Integration* (Springer). In 2016, he joined the *AJGS* as an Associate Editor responsible for evaluating submissions in the fields of Earthquake Geology, Paleoseismology, Archeo-seismology, Seismo-tectonics, and Neo-tectonics.



Dr. Mansour Al-Garni holds a B.Sc. (1993) in Geophysics from King Abdulaziz University (KAU, Saudi Arabia), a M. Sc. (1996) in Geophysics from Colorado School of Mines (Colorado, USA), and a Ph.D. (2001) in Geophysics from Texas A&M University (TAMU, College Station, USA). In 1993, he worked as a Geophysicist at the Ministry of Petroleum and Mineral Resources, United States Geological Survey in Jeddah (Saudi Arabia), and as a Demonstrator of Geophysics at KAU, where he became an Assistant Professor of Geophysics in 2002. He has been promoted to an Associate Professor in 2006 and to a full Professor of Geophysics in 2010. He has been nominated as the Chairman of Geophysics Department (2003–2011), Vice Dean (2014), and Vice Dean for graduate studies and scientific research (2015–Now). His research interests cover controlled-source electromagnetic induction, electrical methods, gravity and magnetic methods, near-surface applied Geophysics, forward and inverse model-

ing, environmental and engineering Geophysics, environmental site characterization, ground penetrating radar, hydrogeophysics, and mining Geophysics: theory, data processing, and interpretation. He has reviewed a lot of academic works and has been in many committees including those of M.Sc. and Ph.D. examinations. His remarkable efforts in the establishment and development of various projects were reflected in valuable academic and professional successes and achievements. He has conducted more than 15 research projects, the most recent of which involved EM, DC resistivity, SP, IP, and magnetic methods for mineral exploration in the Arabian Shield. He has published more than 50 research articles in international indexed and refereed journals. He has been listed in the “Marquis Who’s who in the World” as one of the world’s foremost achievers in the field of Geophysics in the 28th Edition (2011). In 2015, he joined the AJGS as an Associate Editor responsible for evaluating submission in the fields of Theoretical and Applied Exploration Geophysics.



Dr. Bernard Giroux holds a B.Sc.A. in engineering physics (1992) from Laval University (Canada) and a M.Sc.A. (1994) and Ph.D. (2001), both in applied geophysics from École Polytechnique de Montréal (Canada). He is currently Associate Professor at the Institut National de la Recherche Scientifique, Centre Eau-Terre-Environnement in Quebec city (Canada). His research interests include geophysical monitoring, near-surface geophysics, numerical modeling, geophysical inversion, and data assimilation. During the last years, his work focused largely on improving methods for quantitative interpretation and monitoring of CO₂ storage. In 2016, Dr. Giroux joined the AJGS as an Associate Editor responsible for evaluating submissions in Applied Geophysics.