
Advances in Science, Technology & Innovation

IEREK Interdisciplinary Series for Sustainable
Development

Editorial Board Members

Hassan Abdalla
Md. Abdul Mannan
Chaham Alalouch
Sahar Attia
Sofia Natalia Boemi
Hocine Bougdah
Emmanuel Bozonnet
Luciano De Bonis
Dean Hawkes
Stella Kostopoulou
Yasser Mahgoub
Saleh Mesbah Elkaffas
Nabil Mohareb
Iman O. Gawad
Mieke Oostra
Gloria Pignatta
Anna Laura Pisello
Federica Rosso
Biswajeet Pradhan

Series editor

Mourad Amer

Advances in Science, Technology & Innovation (ASTI) is a series of peer-reviewed books based on the best studies on emerging research that redefines existing disciplinary boundaries in science, technology and innovation (STI) in order to develop integrated concepts for sustainable development. The series is mainly based on the best research papers from various IEREK and other international conferences, and is intended to promote the creation and development of viable solutions for a sustainable future and a positive societal transformation with the help of integrated and innovative science-based approaches. Offering interdisciplinary coverage, the series presents innovative approaches and highlights how they can best support both the economic and sustainable development for the welfare of all societies. In particular, the series includes conceptual and empirical contributions from different interrelated fields of science, technology and innovation that focus on providing practical solutions to ensure food, water and energy security. It also presents new case studies offering concrete examples of how to resolve sustainable urbanization and environmental issues. The series is addressed to professionals in research and teaching, consultancies and industry, and government and international organizations. Published in collaboration with IEREK, the ASTI series will acquaint readers with essential new studies in STI for sustainable development.

More information about this series at <http://www.springer.com/series/15883>

Federico Rossetti • Ana Crespo Blanc
Federica Riguzzi • Estelle Leroux
Kosmas Pavlopoulos • Olivier Bellier
Vasilios Kapsimalis
Editors

The Structural Geology
Contribution
to the Africa-Eurasia Geology:
Basement and Reservoir
Structure, Ore Mineralisation
and Tectonic Modelling

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

Editors

Federico Rossetti
Università Roma Tre
Roma, Italy

Ana Crespo Blanc
University of Granada
Granada, Spain

Federica Riguzzi
Istituto Nazionale di Geofisica e Vulcanologia
Roma, Italy

Estelle Leroux
Unité Géosciences Marines—IFREMER
Plouzané, France

Kosmas Pavlopoulos
Paris Sorbonne University Abu Dhabi
Abu Dhabi, United Arab Emirates

Olivier Bellier
Centre Européen de Recherche et d'Enseignement
en Géosciences de l'Environnement (CEREGE)
Aix-en-Provence, France

Vasilios Kapsimalis
Institute of Oceanography
Anavyssos, Greece

ISSN 2522-8714 ISSN 2522-8722 (electronic)
Advances in Science, Technology & Innovation
IEREK Interdisciplinary Series for Sustainable Development
ISBN 978-3-030-01454-4 ISBN 978-3-030-01455-1 (eBook)
<https://doi.org/10.1007/978-3-030-01455-1>

Library of Congress Control Number: 2018960212

© Springer Nature Switzerland AG 2019, corrected publication 2019

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.

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.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

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

Foreword

Deep seismic imagery and mantle tomography have considerably increased our understanding of the lithosphere and crustal architecture, as well as sedimentary basin formation and deformation processes. In the meantime, high-resolution seismic reflection profiles, as calibrated against exploration wells and outcrop studies, also provide a better control of the sedimentary infill and 3D reservoir architecture. Seemingly, source-to-sink studies, coupled with subsidence and kinematic modelling calibrated against paleothermometers, provide accurate reconstructions of the long-term tectono-stratigraphic evolution of sedimentary basins. Thermal and fluid flow modelling are now routinely used to better understand and predict the formation and distribution of ore deposits and petroleum potential, along with the permeability distribution of their hosting reservoirs.

These proceedings volume comprises 74 papers accepted for presentation during the 1st Springer Conference of the Arabian Journal of Geosciences (CAJG-1), Tunisia, 2018. The major topics and issues treated include: (i) Basement geology; (ii) Fluid–rocks interactions, hydrothermalism and ore deposits; (iii) Reservoir geology, structure and stratigraphy; (iv) Mediterranean tectonics; (v) The Alpine-Himalayan convergence zone; (vi) Tectonic modelling.

Individual papers presented in this respect range from local case studies, predominantly relating to the North African, Mediterranean and Mid-Eastern regions, to more global geodynamic syntheses dealing with continental break-ups, oceanic accretion and passive margins' development. The present document will provide an updated portfolio, evidencing the input of structural geology to the understanding of lithosphere and crustal-scale processes activating in the broader Afro-Eurasian realm. It is intended to stand as a highly interesting reference for both students and senior scientists and professionals.

August 2018

François Roure



François Roure is a graduate of the Ecole Normale Supérieure of St-Cloud, France, holder of a Doctorate in Sciences from the University of Paris VI. He joined the IFP's Geology-Geochemistry-Geophysics Division in 1984, following a 4-year career at the CNRS. His research is predominantly focused on the study of sedimentary basins (architecture and geodynamics, thermicity, oil-bearing systems, fluid/rock interactions and reservoir characterization). He was selected as an extraordinary Professor at the Free University of Amsterdam (VU). He also chaired the working group on sedimentary basins in the International Lithosphere Program (ILP). He has contributed more than a hundred articles, published in prestigious international journals.

In 2010, François Roure was honoured by the EAGE (European Association of Geoscientists and Engineers), which selected him as the winner of the 2010 Wegener Award, as a recognition of his contribution to the geoscientific research in the area of petroleum exploration of frontier areas and the search for new reserves, particularly in mountain belts.

Acknowledgements

Our appreciation is extended to the authors of the papers for their hard and diligent work and 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 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 at the wide-ranging fields of Earth sciences. The conference covered all crosscutting 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. Geo-environmental 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, paleontology, 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:

Volume 1. Patterns and Mechanisms of Climate, Paleoclimate, and Paleoenvironmental Changes from Low-Latitude Regions

Zhihua Zhang (AJGS Editor): Beijing Normal University, Beijing, China

Nabil Khélifi (AJGS Editor): Earth Sciences Editorial Department, Springer, Heidelberg, Germany

Abdelkader Mezghani (Guest Editor): Norwegian Meteorological Institute, Norway

Essam Heggy (Guest Editor): University of Southern California and NASA Jet Propulsion Laboratory, Caltech, USA

Volume 2. Advances in Remote Sensing and Geo informatics Applications

Hesham M. El-Askary (Guest Editor): Schmid College of Science and Technology at Chapman University, USA

Saro Lee (AJGS Editor): Korea Institute of Geoscience and Mineral Resources, Daejeon, South Korea

Essam Heggy (Guest Editor): University of Southern California and NASA Jet Propulsion Laboratory, Caltech, USA

Biswajeet Pradhan (AJGS Editor): University of Technology Sydney, Sydney, Australia

Volume 3. Recent Advances in Geo-Environmental Engineering, Geomechanics and Geotechnics, and Geohazards

Amjad Kallel (AJGS Editor): ENIS, University of Sfax, Tunisia

Zeynal Abiddin Erguler (AJGS Editor): Dumlupinar University, Kutahya, Turkey

Zhen-Dong Cui (AJGS Editor): China University of Mining and Technology, Xuzhou, Jiangsu, China

Ali Karrech (AJGS Editor): The University of Western Australia, Australia

Murat Karakus (AJGS Editor): University of Adelaide, Australia

Pinnaduwa Kulatilake (AJGS Editor): Department of Materials Science and Engineering, The University of Arizona, USA

Sanjay Kumar Shukla (AJGS Editor): School of Engineering, Edith Cowan University, Perth, Australia

Volume 4. Exploring the Nexus of Geocology, Geography, Geoarcheology, and Geotourism: Advances and Applications for Sustainable Development in Environmental Sciences and Agroforestry Research

Haroun Chenchouni (AJGS Editor): University of Tebessa, Algeria

Ezzoura Errami (Guest Editor): Chouaib Doukkali University, El Jadida, Morocco

Fernando Rocha (Guest Editor): University of Aveiro, Portugal

Luisa Sabato (AJGS Editor): Università degli Studi di Bari 'Aldo Moro', Bari, Italy

Volume 5. On Significant Applications of Geophysical Methods

Narasimman Sundararajan (AJGS Editor): Sultan Qaboos University, Muscat, Oman

Mehdi Eshagh (AJGS Editor): University West, Trollhättan, Sweden

Hakim Saibi (AJGS Editor): United Arab Emirates University, Al-Ain, Abu Dhabi, UAE

Mustapha Meghraoui (AJGS Editor): Université de Strasbourg, Strasbourg, France

Mansour Al-Garni (AJGS Editor): King Abdulaziz University, Jeddah, Saudi Arabia

Bernard Giroux (AJGS Editor): Centre Eau Terre Environnement, Québec, Canada

Volume 6. Advances in Sustainable and Environmental Hydrology, Hydrogeology, Hydrochemistry, and Water Resources

Helder I. Chaminé (AJGS Editor): School of Engineering—ISEP, Polytechnic of Porto, Portugal

Maurizio Barbieri (AJGS Editor): University of Roma La Sapienza, Italy

Ozgur Kisi (AJGS Editor): Ilila State University, Tbilisi, Georgia

Mingjie Chen (AJGS Editor): Sultan Qaboos University, Muscat, Oman

Broder J. Merkel (AJGS Editor): TU Bergakademie Freiberg, Freiberg, Germany

Volume 7. Petrogenesis and Exploration of the Earth's Interior

Domenico Doronzo (AJGS Editor): Consejo Superior de Investigaciones Científicas, Spain

Emanuela Schingaro (AJGS Editor): Università degli Studi di Bari Aldo Moro—UniBa, Italy

John S. Armstrong-Altrin (AJGS Editor): The National Autonomous University of Mexico, Mexico

Basem Zoheir (Guest Editor): Benha University, Egypt and University of Kiel, Germany

Volume 8. Advances in Petroleum Engineering and Petroleum Geochemistry

Santanu Banerjee (AJGS Editor): Indian Institute of Technology Bombay, Mumbai, India

Reza Barati (AJGS Editor): The University of Kansas, Lawrence, KS, USA

Shirish Patil (Guest Editor): Saudi Aramco and King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia

Volume 9. Paleobiodiversity and Tectono-sedimentary Records in the Mediterranean Tethys and Related Eastern Areas

Mabrouk Boughdiri (AJGS Editor): University of Carthage, Amilcar, Tunisia

Beatriz Bádenas (AJGS Editor): University of Zaragoza, Zaragoza, Spain

Paul Selden (AJGS Editor): University of Kansas, Lawrence, Kansas, USA

Etienne Jaillard (Guest Editor): Université Grenoble Alpes, France

Peter Bengtson (AJGS Editor): Universität Heidelberg, Heidelberg, Germany

Bruno R. C. Granier (AJGS Editor): Université de Bretagne Occidentale, Brest, France

**Volume 10. The Structural Geology Contribution to the Africa-Eurasia Geology:
Basement and Reservoir Structure, Ore Mineralisation and Tectonic Modelling**

Federico Rossetti (Guest Editor): Università Roma Tre, Roma, Italy

Ana Crespo Blanc (Guest Editor): University of Granada, Spain

Federica Riguzzi (Guest Editor): National Institute of Geophysics and Volcanology, Roma, Italy

Estelle Leroux (Guest Editor): IFREMER, Unité Géosciences Marines, Plouzané, France

Kosmas Pavlopoulos (Guest Editor): Paris Sorbonne University Abu Dhabi, Abu Dhabi, UAE

Olivier Bellier (Guest Editor): CEREGE, Aix-en-Provence, France

Vasilios Kapsimalis (Guest Editor): Institute of Oceanography, Hellenic Centre for Marine Research, Anavyssos, Greece

About the Conference Steering Committee

General Chair



Abdullah Al-Amri: Founder and Editor-in-Chief of AJGS, King Saud University, Saudi Arabia

Conference Supervisor



Nabil Khélifi: Senior Publishing Editor, Springer Middle East and North African Program Springer, a part of Springer Nature, Heidelberg, Germany

Scientific Committee Chair

François Roure: Guest of Editorial Board of AJGS, IFP—
Energies Nouvelles, France



Walter D. Mooney: Guest of Editorial Board of AJGS,
US Geological Survey Western Region, USA

Local Organization Chair

Mabrouk Boughdiri: Associate Editor of AJGS, University of
Carthage, Bizerte, Tunisia

Evaluation Chair



Amjad Kallel: Assistant Editor of AJGS, ENIS, University of Sfax, Tunisia

Publication Chair



Biswajeet Pradhan: Associate Editor of AJGS, University of Technology Sydney, Sydney, Australia



Essam Heggy: Guest of Editorial Board of AJGS, University of Southern California and NASA Jet Propulsion Laboratory, Caltech, USA

Program Chair

Hakim Saibi: Associate Editor/Assistant Editor of AJGS, United Arab Emirates University, Al-Ain, Abu Dhabi, UAE



Domenico Doronzo: Associate Editor/Assistant Editor of AJGS, Consejo Superior de Investigaciones Cientificas, Spain

Communication Chair

Mohamed Ksibi: Guest of Editorial Board of AJGS, ISBS, University of Sfax, Tunisia

English Language Advisory Committee

Abdelmajid Dammak: ENIS, University of Sfax, Tunisia

Chokri Khalaf: FMS, University of Sfax, Tunisia

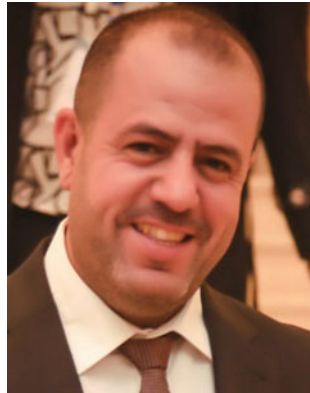
Dhouha Mabrouk: FLSHS, University of Sfax, Tunisia

Mohamed Elbahi: ENIS, University of Sfax, Tunisia

Sami Shami: ENIS, University of Sfax, Tunisia

Yasmine Basha: FLSHS, University of Sfax, Tunisia

Conference Manager



Mohamed Sahbi Moalla: Coordinator of AJGS, ISET,
University of Sfax, Tunisia

Contents

Part I Keynote

- Mediterranean Sea Level and Bathymetry of the Deep Basins During the Salt Giant Deposition: Inference from Seismic and Litho-Facies** 3
C. Gorini, L. Montadert, and B. Haq
- The Alps Revisited—4D-MB, the German Contribution to the Alp Array Mission** 7
Michael Weber, Mark Handy, and Emanuel Kästle
- Tethyan and Alpine Controls on the Crustal Architecture of the Tunisian and Algerian Atlas and Tell: Needs for Coupled Deep Seismic Soundings and Tomography** 11
François Roure, Sami Khomsi, Dominique Frizon de Lamotte, and Rémi Lepretre
- Impact of Geodynamics on Tectonic and Climatic Risk Instabilities in Interior Seas: Insights of Land-to-Sea Study on Caribbean Pathways (Haiti). Potential Application on Mediterranean** 15
Nadine Ellouz-Zimmermann
- Eduard Suess and the Essence of Geology** 19
A. M. Celal Şengör

Part II Basement Geology

- Variation of Subsurface Resistivity in the Pan-African Belt of Central Africa** 25
Dieudonné Bisso, Zakari Arétouyap, Georges Nshagali Biringanine, Philippe Njandjock Nouck, and Jamal Asfahani
- New Insights into the Tectonic Windows of the Eastern Desert of Egypt: An Integrated Field and Remote Sensing Approach** 29
Zakaria Hamimi, Mahmoud Hegazy, and Hatem Aboelkhair
- Development of Quartz Ribbons in Felsic Granulites Under Strong Coaxial Deformation in the Highland Complex of Sri Lanka** 33
Bhathiya Athurupana, Jun Muto, and Hiroyuki Nagahama
- Tectonic Evolution of the Metamorphic Core Complex Around the Kotah and Loe Sar Domes, Swat, North Pakistan** 37
Asghar Ali and Hikmat Salam
- Archean Continental Crust Beneath Mauritius, and Low Oxygen Isotopic Compositions from the Malani Rhyolites, Rajasthan, (India): Implication for the Greater Malani Supercontinent with Special Reference to South China, Seychelles and Arabian-Nubian Shield** 41
Naresh Kochhar

Part III Fluid-Rock Interaction, Hydrothermalism and Ore Deposits

The Lithological, Stratigraphical, Structural Control of Quartzites Hosting Sulphide Mineralisation in the Proterozoic Shillong Group, Meghalaya, India	49
Sumit Kumar Mitra	
Epithermal Hg, Sb and Au Deposits in the Continental Rift Zones of the Menderes Massif, Western Anatolia, Turkey	55
Nevzat Özgür	
Rare Earth Element Signatures of the Bled M'Dena Porphyry Molybdenum-Copper System, Eglab Massif (SW, Algeria)	61
Karima Lagraa, Stefano Salvi, and Didier Béziat	
Heavy Metals in Mine Waters of Diverse Mineralization of Polygenetic Ore-Magmatic System: Merisi Ore Cluster, Achara Region (Georgia)	65
Archil Magalashvili, Levan Doliashvili, Kakhaber Karchkhadze, and Akaki Nadaraia	
Geochemical Characters of the Fluids Involved in the Genesis of the Tebessa Region Mineralizations (North-East Algeria)	69
Azzedine Bouzenoune	
Quartz-Rich Fault Rocks as Potential High Purity Quartz Source (I) in a Sequence of the Central Cameroon Shear Zone (Etam Shear Zone): Geology and Structure	75
Cyrille Sigue, Amidou Moundi, Jean Lavenir Ndema Mbongue, Akumbom Vishiti, Arnold Chi Kedia, Cheo Emmanuel Suh, and Jean Paul Nzenti	
Travertine-Tufa Deposition in Relation with Gafsa-Jeffara Fault System: Implication on Fluid-Flow (Southern Tunisia)	79
Saber Idriss, Samir Bouaziz, and Soumyajit Mukherjee	
The Tsvavorite (Gem Quality Vanadium Grossularite) Minerogenetic System in East Africa	85
Walter L. Pohl	
Sedimentary Structure Interpretation, Grain Size Analysis, and Stochastic Modeling of P₂O₅ Grades of Kef Essennoun Phosphorite Deposit (Northeast Algeria): Implication for Paleogeographic Setting and Paleoprocesses	89
Mohamed Dassamiour, Hamid Mezghache, Otmane Raji, and Jean-Louis Bodinier	
Part IV Reservoir Geology, Structure and Stratigraphy	
Clay Minerals in Fluvial Shaly Sandstone of Upper Triassic Reservoir (TAGS)—Toual Field SE Algeria: Identification from Wireline Logs and Core Data	95
El Hadi Mazouz, Messaoud Hamimed, Abdelouhab Yahiaoui, Mohamed Said Benzagouta, Mohamed Khodja, Nada Achi, and Joëlle Duplay	
The Paleozoic Geology of Saudi Arabia: History, Tectono-Stratigraphy, Glaciations, and Natural Resources	99
Abdulaziz A. Laboun	
Paleozoic Reservoir Distribution in South-Eastern Tunisia	105
Maroua Ghalgaoui, Noomen Dkhaili, Kawthar Sbei, and Mohamed Hedi Inoubli	

Characteristics of Bleaching Around Major Structures in a Reservoir-Cap Rock System, SE Utah, USA	111
Young-Seog Kim, Kyoungtae Ko, and Jin-Hyuck Choi	
Identification and Distribution of Jurassic Paleo-Reservoirs in the Central Junggar Basin, NW China	117
Gang Liu	
Reservoir Properties and Facies Distribution of Mishrif Formation in Ratawi Oilfield, Southern Iraq	121
Furat A. Al-Musawi, Rami M. Idan, and Amani L. M. Salih	
Evaluation of Natural Fractures and Their Impact on Gas Production Using Image Logs (Sirte Basin, NE Libya)	127
Abedlgani Elrafadi, Mohamed Alwerfali, Walid S. Elbarghathe, Seraj Y. Bosnina, and Ali G. Najem	
Characterization of Stylolite Networks in Platform Carbonates	131
Elliot Humphrey, Enrique Gomez-Rivas, Juan Diego Martín-Martín, Joyce Neilson, Yao Shuqing, and Paul D. Bons	
Mumbai High Metamorphic Basement Reservoirs—An Integrated Workflow Based Approach for Fracture Modelling and Real Time Planning and Monitoring	135
S. K. Mukherjee and S. N. Chitnis	
Characterizing Pandanallur Fractured Basement Reservoir: A G and G Enigma	139
S. K. Mukherjee, J. Sarkar, and S. B. Chitnis	
Petroleum Play Potential in the Thrust and Fold Belt Zone of the Offshore Timor-Tanimbar, Eastern Indonesia	145
Sugeng Sapto Surjono, Muhamad Rizki Asy'ari, and Arif Gunawan	
Origin and Preservation of Microbialite-Dominated Carbonate Reservoirs, Lower Cambrian Xiaerbulake Formation, Tarim Basin (China)	149
Qingyu Huang, Suyun Hu, Wei Liu, Tongshan Wang, and Congsheng Bian	
Insight into the Tectonics of the Kaboudia Area and Related Petroleum Systems, Eastern Tunisian Offshore (Tunisia)	153
Mohamed Arab, Mohamed Hassaim, Chokri El Maherssi, Karim Belabed, and François Roure	
Structural Styles, Petroleum Habitat and Traps in the Pelagian-Sirt Basins, Northern Africa: An Overview and Future Exploration Developments	159
Sami Khomsi, Francois Roure, Najoua Ben Brahim, Chokri Maherssi, Mohamed Arab, and Mannoubi Khelil	
Integrated Study of Bentiu and Aradeiba Reservoir Formations, Hamra East Oil Field—Muglad Rift Basin, Sudan	163
Tourkman Omayma, Cerepi Adrian, Mohamed Nuha, Zaroug Izzeldin, and Hussein Rashid	
Organo-Geochemical, Petrography and Spectroscopy of Organic Matter Associated Ypresianphosphatic Series of the Maknassy-Mezzouna Basin Central Tunisia	167
Faten Jaballi, Mongi Felhi, Adnen Lafi, Kamel Zayani, and Ali Tlili	

Application of Seabed Core Geochemistry for Further Exploration in Banggai-Sula Area	171
Sugeng Sapto Surjono, Muhamad Rizki Asy'ari, and Arif Gunawan	
South Tunisia, Structures and Traps Evolution: A Review from a New 3D Mega-Merge Survey	175
Ferid Adouani, Ahmed Saadi, Francis Chevalier, and Noura Ayari	
Integrated Petrophysical Study of Acacus Reservoir (South of Tunisia)	179
Garci Sana	
Behavior of Evaporitic Material During the Structuration of the Eastern Saharian Atlas, Impact on Oil Prospects	183
Chacha Aziza, Zellouf Khemissi, and Belfar Farid	
The State of the Nearshore Bottom as an Index of the Shore State, South Baltic Coast Examples	187
Kazimierz Szeffler, Radosław Wróblewski, Janusz Dworniczak, and Stanisław Rudowski	
Regional Basement Interpretation and Its Impact on Ordovician and Silurian Structures (Ghadames Basin)	191
Dalila Samaali, Sarah Boudriga, Walid Mahmoudi, and Ahmed Nasri	
The Lithostratigraphic Analysis and Petrophysical Characterization of the Campanian-Maastrichtian Formation in the Pelagian Basin (Northeast Tunisia)	197
Wafa Abdelkhalek, Fetheddine Melki, Klaus Bauer, Michael Weber, and Abdelhamid Ben Salem	
Fracture Properties in Naturally Fractured Carbonate Reservoir (Gourigueur Eocene Syncline, North-Eastern Algeria)	201
Saad Hireche, Azzedine Bouzenoune, and Djelel Bouti	
Part V Mediterranean Tectonics	
Polyphasic Tectonic on the Deformation Zone in the Northern Foothill of the Blida Atlas, the Cross Section of Hammam Melouane, Algeria	207
Seifeddine Adjiri, Mohamed Naak, and Abdelkrim Yelles-Chaouche	
Late Hercynian and Alpine Deformation in Sidi Abdelaziz Area Small Kabylie—Algeria	213
Nacer-eddine Bouzekria	
Extensional Attenuation of Foreland Thrust Belts in the Western Mediterranean	217
Guillermo Booth-Rea, Seiffeddine Gaidi, Lluis Moragues, Fetheddine Melki, Jose Miguel Azañón, Wissem Marzougui, Jorge Pedro Galvé, and Vicente Perez-Peña	
Genetically Linked Sedimentary Basins to Define a Kinematic Model of the Central Mediterranean Extension	221
Alfonsa Milia and Maurizio Maria Torrente	
Multidisciplinary Study of the Central High Atlas Diapiric Province in Morocco: Results from Analogue and Numerical Models	225
Jaume Vergés, Mar Moragas, and Jonas Ruh	

Analogical Compression Modeling of the Tunisian Atlas in the Mediterranean Context	229
Rabeb Dhifaoui, Pierre Strzeczynski, Régis Mourgues, Adel Rigane, and Claude Gourmelen	
Compressional Tectonics Since Late Maastrichtian to Quaternary in Tunisian Atlas	233
Hedi Zouari, Achraf Zouari, and Fehmy Belghouthi	
The External Domain of Maghrebides Belt on the North–East of Algeria, Souk Ahras Segment: Definition of Structural Units, Block Structure and Timing of Thrusts Setting	237
Abdallah Chabbi, Asma Chermiti, Abdelmadjid Chouabbi, and Mohamed Benyoussef	
Sedimentology and Petrographic Analyses of the Upper Cretaceous and Lower Eocene Carbonate Deposits in the Mateur-Beja Area (NW of Tunisia): The Repercussions of Tectonic Style on Sedimentation	243
Fehmy Belghouthi, Achraf Zouari, and Hedi Zouari	
Is the Mejerda Wedge-Top Basin of Northern Tunisia a Consequence of Basal Friction Change? a Theoretical and Experimental Approach	247
Mannoubi Khelil, Pauline Souloumiac, Dominique Frizon de Lamotte, Sami Khomsi, Bertrand Maillot, Seifeddine Gaidi, Mourad Bedir, and Fouad Zargouni	
Hinterland-Verging Thrusting in the Northern Sicily Continental Margin: Evidences for a Late Collisional Stage of the Sicilian Fold and Thrust Belt?	251
Attilio Sulli, Maurizio Gasparo Morticelli, Mauro Agate, and Elisabetta Zizzo	
Plio-Quaternary Shortening Structures in Northern Tunisia	255
Seifeddine Gaidi, Guillermo Booth-Rea, José Vicente Pérez, Fetheddine Melki, Wissem Marzougui, Mannoubi Khelil, Fouad Zargouni, and José Miguel Azañón	
The “Eovariscan Synmetamorphic Phase” of the Moroccan Meseta Domain Revisited; A Hint for Late Devonian Extensional Geodynamics Prior to the Variscan Orogenic Evolution	259
Hassan Ouanaïmi, Abderrahmane Soulaïmani, Christian Hoepffner, and André Michard	
Paradigmatic Examples of Lateral Spreading Phenomena in the Betic-Rif and Maghrebian Chains	263
Seifeddine Gaidi, Cristina Reyes Carmona, Jorge Pedro Galve Arnedo, José Vicente Pérez, Fetheddine Melki, Booth Rea Guillermo, Antonio Jabaloy, Wissem Marzougui, and José Miguel Azañón	
Remote Sensing Imagery Contribution to Structural Mapping and Analysis of Tin Tarabine Region (Central Hoggar, Algeria)	267
Kawther Araïbia, Kamel Amri, and Chakib Harouz	
New Evidence of Active Faulting Along the Ain Smara Fault in the Constantine Province (North East Algeria)	271
Yahia Mohammedi, Hamou Djellit, Abdlkrim Yelles-Chaouche, Mouloud Hamidatou, and Nassim Hallal	
Gravimetric Study of the Khemis Miliana Plain (Upper Cheliff Basin): Structure of the Transition Zone Between the Cheliff and Mitidja Basin (North of Algeria)	275
Mohamed Bendali, Boualem Bouyahiaoui, Hassina Boukerbout, Billel Nèche, Salah-Eddine Bentrìdi, and Abdeslam Abtout	

Neotectonic Analysis of an Alpine Strike Slip Fault Zone, Constantine Region, Eastern Algeria	279
Sahra Aourari, Djamel Machane, Hamid Haddoum, Saber Sedrati, Nadia Sidi Saïd, and Djillali Bouziane	
Pan-African Transpression in the Tahifet Area (AzrouN’Fad Terrane, Central Hoggar, Algeria)	285
Kamel Amri and Yamina Mahdjoub	
Aptian-Albian Diapirism and Compressional Tectonics Since Late Maastrichtian to Quaternary in Mateur-Tebourba Region (Northern Tunisian Atlas)	289
Achraf Zouari, Hedi Zouari, and Fehmy Belghouthi	
USE of Landsat 8 OLI Images to the Characterization of Hercynian Deformation of the Ougarta (South-West Algeria)	293
Chakib Harouz, Kamel Amri, Rachid Hamdidouche, and Kawther Araibia	
Part VI The Alpine Himalayan Convergence Zone	
The Role of Izeh Transverse Fault Zone in Zagros, Iran	299
A. Yassaghi	
The Eastern Black Sea and Caucasus Domain Origin and Its Tectonic Evolution: New Insights from Results of a Decade of Field Works and of Geophysical Research	303
Marc Sosson, Randell Stephenson, Shota Adamia, Ara Avagyan, Talat Kangarli, Vitaly Starostenko, Tamara Yegorova, Yevgeniya Sheremet, Eric Barrier, Yann Rolland, Marc Hässig, Zoé Candaux, Victor Alania, Onice Enukidze, Nino Sadradze, Lilit Sahakyan, Ghazar Galoyan, and Sargis Vardanyan	
Northern Dobrogea and the Crimean Mountains: The Key Areas in the Tectonic Evolution of the Black Sea Basin	307
Yevgeniya Sheremet, Marc Sosson, Antoneta Seghedi, and Mihaela C. Melinte-Dobrinescu	
Caucasian-Arabian Syntaxis, The Alpine-Himalayan Continental Collisional Zone	311
Evgenii V. Sharkov	
Tectonic and Eustatic Sea-Level Fluctuations During the Early Cretaceous: A Case Study from the Berriasian–Valanginian Sequences in Saudi Arabia	315
Abdullah O. Bamousa	
Obduction and Collision Tectonics in Oman: Constraints from Structural and Thermal Analyses	319
Eugenio Carminati, Luca Aldega, Luca Smeraglia, Andreas Scharf, and Frank Mattern	
Evidences of Neo-Tectonic Landforms Between Srinagar and Bagwan Area in Lower Alaknanda Valley (Garhwal Himalaya), India	323
Devi Datt Chauniyal	
Part VII Tectonic Modelling	
From Rifting to Spreading: The Proto-Oceanic Crust	329
Philippe Schnürle, Maryline Moulin, Alexandra Afilhado, Mikael Evain, Afonso Loureiro, Nuno Dias, and Daniel Aslanian	

Passive Margin and Continental Basin: Towards a New Paradigm	333
Daniel Aslanian, Maryline Moulin, Philippe Schnürle, Mikael Evain, Alexandra Afilhado, and Marina Rabineau	
Interpretation of Global GPS-Vectors Map	337
Muhammad Hassan Asadiyan Falahiyeh	
Correction to: The Structural Geology Contribution to the Africa-Eurasia Geology: Basement and Reservoir Structure, Ore Mineralisation and Tectonic Modelling	C1
Federico Rossetti, Ana Crespo Blanc, Federica Riguzzi, Estelle Leroux, Kosmas Pavlopoulos, Olivier Bellier, and Vasilios Kapsimalis	

About the Editors



Dr. Federico Rossetti is a holder of a degree in Geological Sciences (1995), and a Ph.D. in Earth Sciences (1999) from the Sapienza University of Roma, Roma (Italy). He is currently Professor of Structural Geology at the University of 'Roma Tre', Roma (Italy). His research is focused on understanding ductile and brittle continental tectonics in different geodynamic settings, as observed on different spatio-temporal scales. He has executed extensive fieldwork across the Alpine-Himalayan convergence zone (Betic-Rif chain, Apennine and Alpine chain, Iran), the Pan-African orogen in Tanzania and the Ross-Delamerian orogen in Antarctica. He was awarded the 2005 'Felice Ippolito Prize' for the category Earth Sciences, for the research he conducted in Antarctica. His approach is multidisciplinary, integrating geological field survey, structural geology, metamorphic petrology and geodynamic synthesis. He has been occupying the position of a Topical Editor for the EGU journal *Solid Earth* ever since 2010, Chief Editor since 2018. He is currently Associate Editor of the AGU journal *Tectonics*. He is the author of more than 100 research papers published in internationally indexed and refereed journals. In 2015, Dr. Rossetti joined the AJGS as an Associate Editor responsible for evaluating submissions pertaining to the areas of Structural Geology, Continental Tectonics and Metamorphic Petrology.



Ana Crespo Blanc born in Switzerland, is a Full Professor of Geodynamics at the University of Granada (Spain) ever since 1993. She occupied the position of President of the Geological Society of Spain, between 2008 and 2012. Her research has been focused mainly on structural and kinematic analysis, relationships between deformation and metamorphism, isotopic geochemistry, marine geology and analogue modelling. She applied these different methodologies to the knowledge of the tectonic evolution of key areas of the Hercynian chain of Iberia, the Alps, the Himalaya or the Nankay Trough. Since the 90s, her research has mainly been centred on the Mediterranean region, specifically, the Betic-Rif orogen around the Gibraltar Arc. She is particularly interested in the architecture and the strain partitioning of such an arcuate orogen. Presently, she is interested in the kinematic reconstructions of the Western Mediterranean, regarding which she characterized, collaboratively with her research group, the different deformation events affecting the whole area. She is simultaneously involved in significant outreach research activities closely associated with earth sciences.



Federica Riguzzi is a holder of a degree in Physics and a Ph.D. in Earth Sciences at the University of Roma La Sapienza. Senior Researcher at Istituto Nazionale di Geofisica e Vulcanologia, Roma, Italy. Her research activity is focused mainly on geodetic methods applied to geophysics. It concerns both methodological and applied studies dedicated to the realization and measurement of crustal deformation control and to fundamental Physics experiment networks; time series analyses of GPS observations, as related to the study of the deformation fields and seismotectonic processes, and the use of historical information and recent seismic data applied to seismic risk areas. The geodetic methodologies have been applied to geophysical studies relating to different regions and with various aims. Her contributions are predominantly centred on the definition of global-scale plate motion models in different reference frames; the study of kinematics and deformation fields of the central Mediterranean and Suez-Sinai areas, along the Betic Cordillera (Spain and Morocco) and the Eastern Himalaya Syntaxis (NE India) through GNSS observations; the analysis of co- and post-seismic deformations after the occurrence of significant seismic events; the estimation of deformation source of the Colli Albani volcano (Roma); the definition of a new methodology based on the joint analysis of deformation rates and seismicity data to assess the earthquake short-term occurrence probability. She has also conducted a number of macroseismic surveys, following the occurrence of significant seismic events, and historical seismicity-related studies. She collaborates with national and international research groups, the Universidad de Jaen (Spain), the National Research Institute of Astronomy and Geophysics (Egypt), as well as the Geological Survey and the Raman Center for

Applied and Interdisciplinary Sciences of Kolkata (India). She has been responsible for the Research Units, financed by the Gruppo Nazionale di Difesa dei Terremoti, and the Department of Civil Defense. Additionally, she took part in several projects supported by the Italian Space Agency. She is an Associate Editor of the *Annals of Geophysics*, and the author of various scientific papers published in reputedly rated national and international journals.



Estelle Leroux obtained her marine technician degree at the National Institute of Science and Marine Technology (INTECHMER), France. She began her career in 2000 working for a few years in a Petroleum Seismic exploration for CGG International (General Company of Geophysics), especially in the Gulf of Mexico offshore. Subsequently, she spent several years reviewing data acquisition and processing on scientific oceanographic vessels, and in different French academic research institutes (IFREMER—French Institute for Marine Research, CNRS—French National Center for Scientific Research, UBO—University of Western Brittany, and IUEM—European University Institute for Marine Research).

She, then, decided to pursue a scientific career. After completing her Ph.D. at UBO/IFREMER on seismic stratigraphy in the Gulf of Lion, in 2012, she joined the UPMC-Sorbonne University, Paris, actively resuming work on seismic and sequence stratigraphy. Her key study areas were centred on the Cenozoic Western Mediterranean area.

In 2016, Estelle Leroux integrated the IFREMER Center in Brest as a marine geologist. Her research was predominantly focused on the combined application of stratigraphy and modelling, in the analysis of ancient and modern sedimentary basin fills. Her expertise is mainly centred on seismic and sequence stratigraphy, as well as numerical geological modelling, both in ‘Source-to-sink’ and ‘Mud-to-Mantle’ approaches.

Her aim is targeting to decode the sediment sequences, sediment architectures and deposit features in past sedimentary basins. It is also dedicated to provide key guides on both qualitative and quantitative paleo-variations of sediment fluxes, sea level, and subsidence in a bid to understand climate and geodynamic changes. She is the (co-)author of scientific publications on internationally recognized peer-reviewed journals, and is also involved in several multidisciplinary projects.



Kosmas Pavlopoulos (KP) was born in Athens, Greece. He received his B.Sc. in Geology, and Ph.D. in Environmental Geomorphology at the University of Athens, Greece in 1986 and 1992, respectively. Since 2013, KP has been a Professor of environmental geomorphology, in the Geography and Planning Department at the University of Paris-Sorbonne, Abu Dhabi. He had been previously appointed in the Geography Department at the Harokopio University, Athens, Greece ever since 1999. He was Chair of the working group on geoarcheology of IAG from 2009 to 2017, and member of the Scientific Committee of the French Archaeological School in Athens, from 2010 to 2017. Since 2017, he has been member of the Executive Committee of IAG (International Association of Geomorphologists), as a Publishing Editor.

He is a recognized specialist in the field of coastal geomorphology, sedimentology, Quaternary geology, sea level changes. His research is predominantly focused on the sediments depositional environments on arid and semi-arid areas, geomorphological evolution of marginal landscapes, sea level changes, hydrogeology and the Wadi dynamics, water resources' management as well as the natural hazards, as predominant in the Mediterranean and Mid-Eastern areas.

He has participated in 62 research projects, and has been the coordinator in 20 among them. He has more than 140 publications in peer-reviewed scientific journals (68 currently shown in Scopus), and his work received more than 677 citations (h-index = 16, co-authors 141, source Scopus) and (156 currently shown in Research Gate), 1181 citations (h-index = 30.88, source Research Gate). KP has been the supervisor of 9 Ph.D., and a member of the supervising committee of 12 Ph.D. students. As an expert in Geosciences and environment, he is member for the evaluation of research projects, launched by the Greek Ministry of Research since 2000, by the French institute of CNRS 2004–2007 (ECLIPSE program), by the French Ministry of Education and Research from 2012–2013 (ANR project), by the MIUR (the Italian Ministry for Education, University and Research) 2015–2016 (Reprise project), and by the Ford Motor Company in 2016 (Conservation and Environmental Grants).



Olivier Bellier is Full Professor of Tectonics Aix Marseille University, CNRS, IRD, INRA, Coll France, CEREGE, Aix-en-Provence, France since 2000. He had been a Joint Director of the Science Faculty of Aix-Marseille (up to 2013), then a Joint director (in charge of the Research) of OSU Pythéas Institute—Observatory of the Universe and Environment of Aix-Marseille University (2013–2018). He is presently a Director of the CEREGE Laboratory (AMU, CNRS, IRD, Collège de Fr., INRA). His research is focused mainly on Tectonics and Seismic hazard: Brittle and active tectonics, Tectonic geomorphology, Structural geology, which he applied to the study of Geodynamics and Geological risks. His research is partly centred on investigating the Mediterranean area: Tunisia, Morocco, SE France, Italy, etc. However, he developed other research collaborations: USA-USGS, China, Peru, Argentina, Venezuela, Indonesia, Turkey, Iran, Armenia, etc. He was a member of the scientific committee of the Sigma program (Seismic Ground Motion Assessment), Consortium EDF, CEA, Areva, ENEL, Italy, (2011–2015), and a member of the scientific committee of the RGF (Référentiel Géologique de la France), the BRGM program, 2014–2017. He was also a member of the Steering Committee of Geological Society of France (Société Géologique de France), 2012–2015, and a member of the expert committee of ECOS Nord (Committee of the scientific cooperation evaluation between France and South America from the Foreign Affairs Ministry (Hubert Curien Program) for Columbia, Venezuela, Mexico. He was leader of the Steering Committee of the International Scientific Congress «Provence 2009 : Seismic risk in moderate seismicity area»—Aix-en-Provence, July 2009, and a leader of the Steering and Scientific Committees of the First International workshop GeoriskMor «Geosciences and Risk assessment in Morocco: an integrated approach» Tétouan (Morocco) 28–30 April 2016, Faculty of Sciences, Abdelmalek-Essaâdi, the University of (Tanger-Tétouan), GeoriskMor project, <http://georisk-morocco.cerege.fr/>, the OT-med workshop. He has been the supervisor of 21 Ph.D. theses since 1991 (19 being presently defended, other in process) and took part in 75 Ph.D. thesis juries, 7 being defended in foreign universities (Iran, Tunisia, Italy, Swiss, etc.). He is the author of 120 international scientific publications (108 indexed in Isi-web of Sciences, in 2018). Besides, he is a co-writer of five scientific books' attached chapters and a co-writer of a chapter of a scientific culture specialized book. He also participated as a co-writer of a jointly scientific culture published book dealing with the Provence earthquake.



Dr. Vasilios Kapsimalis is a Research Director of the Institute of Oceanography of the Hellenic Centre for Marine Research. His scientific interests pertain to the field of marine geology, sediment dynamics and quality, submarine geomorphology, Late Quaternary and Holocene stratigraphy, relative sea level changes, underwater geoarchaeology and management of dredged material coastal erosion. He has published more than 35 papers in peer-reviewed journals, and presented more than 70 original contributions in international and Greek-based conferences. In addition, he has coordinated 25 research projects dealing with sediment quality assessment, monitoring and impact of sediment disposal operations on marine environment, geomorphological mapping of the coastal and offshore areas, paleo-geographical reconstructions of the Greek continental shelf. As a chief scientist, he has organized and participated, in several coastal (in estuarine, lagoonal, beach areas, etc.) and offshore (continental shelves, slopes and deep basins) multi-disciplinary surveys, deploying the HCMR's fleet (R/V AIGAIO and S/V ALKYON). His educational work is related to the teaching of graduate and postgraduate courses at the Harokopio University of Athens (Oceanography), and the National Technical University (Marine Geology and Geophysics), along with the supervision of B.Sc., M.Sc. and Ph.D. theses. Additionally, he has organized a number of international and Greek congresses and workshops of various oceanographic and environmental subjects, and disseminated the results of his work in well-recognized magazines and newspapers. He was the representative of the HCMR (2010–2016) to the Licensing Committee on Marine Research of the Greek Foreign Ministry, which issues licenses for each marine research conducted within the Greek-owned waters.