

SPECIAL ISSUE

VOLUME | ISSUE | YEAR
32 | 8 | 2023
ISSN 1300-0985 . E-ISSN 1303-619X

TURKISH JOURNAL OF

EARTH SCIENCES

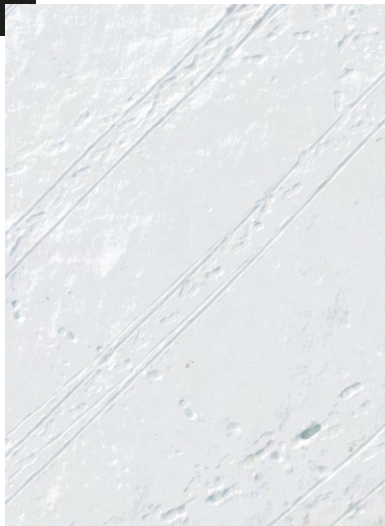
<http://journals.tubitak.gov.tr/earth/>

Advances in Earth Sciences:
enhancing our
understanding of
Polar Regions



Editor-in-Chief
Orhan TATAR

Guest Editors
Burcu ÖZSOY
H. Hakan YAVAŞOĞLU
Naki AKÇAR
Stefan KERN
Yeadong KIM



Published by The Scientific and
Technological Research Council of Türkiye



TURKISH JOURNAL OF EARTH SCIENCES

Editor-in-Chief

Orhan TATAR, Sivas Cumhuriyet University, Türkiye

VOLUME 32 • ISSUE 8 • 2023

Assistant Editor-in-Chief

Baochun HUANG, Peking University, P.R. China

ISSN 1300-0985 • E-ISSN 1303-619X

SCOPE OF THE JOURNAL

- The Turkish Journal of Earth Sciences is electronically published six times a year by The Scientific and Technological Research Council of Türkiye (TÜBİTAK).
- It serves as an international English-language journal dedicated to the publication of significant, original research across a broad spectrum of earth science topics. These encompass geology, structural geology, tectonics, sedimentology, geochemistry, geochronology, paleontology, igneous and metamorphic petrology, mineralogy, biostratigraphy, geophysics, geomorphology, paleoecology, oceanography, and mineral deposits.
- The journal prioritizes the publication of high-quality papers and comprehensive review articles focusing on current and noteworthy topics, accompanied by high-quality illustrations.
- Submitted papers are expected to have regional implications and garner international interest, aligning with the journal's goal of providing a platform for interdisciplinary papers that would be of interest to diverse specialists.
- Specialized papers illustrating significant advancements in specific areas of earth sciences are encouraged. In addition to original and review articles, the journal welcomes discussions on papers recently published in its issues.
- Thematic sets of papers on geological topics or special issues featuring selected conference papers are also part of the journal's scope.
- The journal is open to short articles (up to six printed pages) reporting significant advances in earth sciences with regional impact, ensuring a platform for rapid publication. Contributions are welcome from researchers of all nationalities.

EDITORIAL BOARD

- Alan COLLINS, University of Adelaide, Australia
- Ali İhsan KARAYİĞİT, Hacettepe University, Türkiye
- Alper BABA, İzmir Institute of Technology, Türkiye
- Anastasia KIRATZI, Aristotle University of Thessaloniki, Greece
- Ayşe ÖZDEMİR, Van Yüzüncü Yıl University, Türkiye
- Azad SAĞLAM SELÇUK, Van Yüzüncü Yıl University, Türkiye
- Bilal SARI, Dokuz Eylül University, Türkiye
- Bing SHEN, Peking University, China
- Cenk YALTIRAK, İstanbul Technical University, Türkiye
- Chun-Ming WU, University of Chinese Academy of Sciences, China
- Cüneyt ŞEN, Karadeniz Technical University, Türkiye
- Dornadula CHANDRASEKHARAM, Indian Institute of Technology, India
- Ercan ALDANMAZ, Kocaeli University, Türkiye
- Erdin BOZKURT, Middle East Technical University, Türkiye
- Erhan ALTUNEL, Eskişehir Osmangazi University, Türkiye
- Fadime SERTÇELİK, Kocaeli University, Türkiye
- Gültekin TOPUZ, İstanbul Technical University, Türkiye
- Gürol SEYİTOĞLU, Ankara University, Türkiye
- H. Serdar AKYÜZ, İstanbul Technical University, Türkiye
- Hadii Shafaii MOGHADAM, Damghan University, Iran
- Halil GÜRSOY, Sivas Cumhuriyet University, Türkiye
- Haluk ÖZENER, Boğaziçi University, Türkiye
- Hasan SÖZBİLİR, Dokuz Eylül University, Türkiye
- Iain STEWART, University of Plymouth, United Kingdom
- İsmail Ömer YILMAZ, Middle East Technical University, Türkiye
- Leigh ROYDEN, Massachusetts Institute of Technology, U.S.A.
- M. Cihat ALÇİÇEK, Pamukkale University, Türkiye
- Muazzez ÇELİK KARAKAYA, Konya Technical University, Türkiye
- Mustapha MEGHRAOUI, University of Strasbourg, France
- Naki AKÇAR, Bern University, Switzerland
- Neslihan OCAKOĞLU GÖKAŞAN, İstanbul Technical University, Türkiye
- Nilgün GÜLEÇ, Middle East Technical University, Türkiye
- Nilgün OKAY, İstanbul Technical University, Türkiye
- Nuretdin KAYMAKÇI, Middle East Technical University, Türkiye
- Oğuz Hakan GÖĞÜŞ, İstanbul Technical University, Türkiye
- Orhan KARSLI, Recep Tayyip Erdoğan University, Türkiye
- Osman CANDAN, Dokuz Eylül University, Türkiye
- Osman PARLAK, Çukurova University, Türkiye
- Oya PAMUKÇU, Dokuz Eylül University, Türkiye
- Özcan Yiğit, Çanakkale Onsekiz Mart University, Türkiye
- Qingju WU, Institute of Geophysics, China
- Riccardo CAPUTO, University of Ferrara, Italy
- Sabah YILMAZ ŞAHİN, İstanbul University-Cerrahpaşa, Türkiye
- Sanzhong LI, Ocean University of China, China
- Sarah BOULTON, Plymouth University, United Kingdom
- Seda YOLSAL ÇEVİKBİLEN, İstanbul Technical University, Türkiye
- Semih ERGİNTAV, Boğaziçi University, Türkiye
- Sevinç ÖZKAN ALTINER, Middle East Technical University, Türkiye
- Sibel TATAR ERKÜL, Akdeniz University, Türkiye
- Spyros PAVLIDES, Aristotle University of Thessaloniki, Greece
- Timur USTAÖMER, İstanbul University-Cerrahpaşa, Türkiye
- Yener EYÜBOĞLU, Karadeniz Technical University, Türkiye
- Yixian XU, Zhejiang University, China
- Yunpeng DONG, Northwest University, China

ABSTRACTED AND INDEXED

- Science Citation Index Expanded
- Scopus
- Academic Search Complete
- Inspec

CONTENTS

Geochemistry of the Lake Sediments on Robert Island, South Shetland Islands, Antarctica: implications for weathering processes in Polar areas	944
Merve ÖZYURT, Yılmaz DEMİR, Korhan ÖZKAN, Raif KANDEMİR	
The petrogenesis of analcime in the Coppermine Formation on Robert Island, South Shetland Islands, Antarctica	961
Raif KANDEMİR, Yılmaz DEMİR, Cüneyt ŞEN, Ufuk Celal YAĞCIOĞLU	
The geo/thermochronology of Dismal Island (Marguerite Bay, Antarctic Peninsula)	975
Fatih KARAOĞLAN, Burcu KARATAŞ, Yavuz ÖZDEMİR, Erhan GÜLYÜZ, Oleg VASSILEV, Mahmut Oğuz SELBESOĞLU, Semih GİLDİR	
Water chemistry and pigment composition of 13 lakes and ponds in Maritime Antarctica	989
Korhan ÖZKAN	
Accuracy assessment of glacier depth monitoring based on UAV-GPR on Horseshoe Island, Antarctica	999
Mahmut Oğuz SELBESOĞLU, Mustafa Fahri KARABULUT, Özgün OKTAR, Burak AKPINAR, Oleg VASSILEV, Mehmet ARKALI, Şeyma Nur TUFAN, Alptuğ Şeref AYYILDIZ, Esra GÜNAYDIN, Atilla YILMAZ, Doğaç Baybars İŞILER, Burcu ÖZSOY	
Accuracy investigation of GNSS-reflectometry for sea level monitoring on Horseshoe Island, Antarctica: preliminary results of the Turkish permanent GNSS station (TUR1)	1013
Mahmut Oğuz SELBESOĞLU, H. Hakan YAVAŞOĞLU, M. Fahri KARABULUT, Özgün OKTAR, V. Engin GÜLAL, Himmet KARAMAN, M. Ersel KAMAŞAK	
Applicability of real-time PPP technique in polar regions as an accurate and efficient real-time positioning system .	1022
Reha Metin ALKAN, Serdar EROL, Bilal MUTLU	
Exploring crowdsourcing accountability for mapping Antarctica: a case study using 5 years of social media data	1041
Ayşe Giz GÜLNERMAN	
WebGIS-based data center design for polar science studies: simulation of Türkiye	1052
Müge ŞENEL, H. Hakan YAVAŞOĞLU, Burcu ÖZSOY, Himmet KARAMAN, M. Ümit GÜMÜŞAY	

Preface

The Polar Regions, encompassing the Arctic and Antarctica, are remarkable not only for their unique ecosystems but also for their critical role in understanding global climate systems and their potential for scientific investigations. Türkiye officially launched the National Polar Science Program in 2017, under the auspices of the Presidency and the responsibility of the Ministry of Industry and Technology. The Polar Research Institute, established under the umbrella of The Scientific and Technological Research Council of Türkiye (TÜBİTAK), has been coordinating National Scientific Expeditions to both the Arctic (TASE) and Antarctica (TAE) since 2019. Therefore, this special issue marks a significant milestone in our ongoing commitment to understanding and preserving the Polar Regions, which hold immense strategic significance and scientific interest for our nation and the global community.

As TÜBİTAK, we have embarked on the National Polar Sciences Program with a clear vision: to deepen our understanding of Polar Regions through nationally based research and technological innovations. Our objective is not only to advance scientific knowledge but also to demonstrate how technology can be a force for good in the most extreme environments on Earth. In this regard, this special issue, consisting of nine research articles, also highlights how our nationally based technological assets have been pivotal in collecting data, monitoring environmental changes, and providing insights into the unique ecosystems of the Polar Regions.

Moreover, this special issue serves as a testament to the collaborative spirit that defines our scientific community. The contributions of both national and international researchers from various aspects of Earth Sciences reflect a diverse tapestry of expertise and perspectives, all united by a common goal-to discover and preserve these extraordinary regions. Therefore, their work, supported by TÜBİTAK KUTUP 1001 programs, is not just a scientific project; it is a critical investment in the future of our planet.

We are committed to fostering international collaboration in TÜBİTAK-funded project calls related to the Polar Regions and our National Scientific Expeditions (TAE and TASE). The scientific outcomes presented in this special issue are not only a reflection of what our National Polar Science Program has achieved but also a roadmap for future projects and collaborations. In this regard, I would like to extend my deepest gratitude to all the scientists who have contributed to this special issue, as well as to the editorial board and the production team of this special issue in the Turkish Journal of Earth Sciences.

Prof. Dr. Hasan MANDAL

The President of The Scientific and Technological Research Council of Türkiye (TÜBİTAK)

Preface

Polar research stands at the forefront of scientific investigations in the era of climate change and environmental challenges. The launch of this special issue on Polar Sciences in the Turkish Journal of Earth Sciences is therefore both timely and significant, aligning with the pivotal role of Polar Regions in advancing our understanding of Earth's changing climate and ecosystems. The National Polar Science Program in Türkiye has been at the helm of coordinating extensive research efforts in both the Arctic and Antarctic regions since 2017. These initiatives have not only expanded our knowledge but also demonstrated the critical importance of polar studies in addressing global environmental concerns. This special issue is a direct outcome of these efforts, presenting nine research articles that encompass various aspects of Earth Sciences. These studies are enriched by the collaborative spirit fostered under the National Polar Science Program, bringing together experts from various fields and countries to explore these remote yet crucial areas of our planet. I would like to express my profound gratitude to Prof. Dr. Hasan Mandal, the President of TÜBİTAK, for providing invaluable support, and to Mehmet Mirat Satođlu, the Director of ULAKBİM along with the entire publication team for their technical support in bringing this special issue to fruition. I extend my thanks to Prof. Dr. Burcu Özsoy (TÜBİTAK MAM KARE, Türkiye), Assoc. Prof. Dr. H. Hakan Yavaşođlu (TÜBİTAK MAM KARE, Türkiye), Assoc. Prof. Dr. Naki Akçar (Bern University, Switzerland), Dr. Stefan Kern (Hamburg University, Germany), and Dr. Yeadong Kim (Scientific Committee on Antarctic Research) for their meticulous effort in guest editorship. I would like to extend my sincere gratitude to all authors and reviewers whose great contributions have played a crucial role in the realization of this special issue.

Prof. Dr. Orhan TATAR
Editor-in-Chief

Advances in Earth Sciences: enhancing our understanding of Polar Regions

Guest Editors: Burcu Özsoy^{1,2}, H. Hakan Yavaşoğlu^{1,3}, Naki Akçar⁴, Stefan Kern⁵, Yeadong Kim⁶

¹ Polar Research Institute, TÜBİTAK Marmara Research Center, Kocaeli, Türkiye

² Department of Maritime Transportation and Management Engineering, İstanbul Technical University, İstanbul, Türkiye

³ Department of Geomatics Engineering, İstanbul Technical University, İstanbul, Türkiye

⁴ Institute of Geological Sciences, University of Bern, Bern, Switzerland

⁵ Integrated Climate Data Center (ICDC), Center for Earth System Research and Sustainability (CEN), University of Hamburg, Hamburg, Germany

⁶ Scientific Committee on Antarctic Research (SCAR)

The inevitable impacts of extreme weather events, combined with the incremental growth of the population and increased exploitation of natural resources, continue to jeopardize the sustainability of Earth's natural resources and processes. The Polar Regions, crucial components of global climate change, are under the threat of irremediable catastrophe. Therefore, scientific communities worldwide have largely focused their attention on exploring the Polar Regions, with special emphasis on Antarctica and the Arctic.

Türkiye has been officially involved in Polar research since 2017 when the first Turkish Antarctic Expedition, under the auspices of the Presidency of the Republic of Türkiye and supported by the Turkish Ministry of Industry and Technology, was conducted. However, Polar research in Türkiye dates back to the 1960s, with many Turkish researchers making individual scientific contributions. In pursuit of the İTÜ Polar Research Centre (2015), the Polar Research Institute under the umbrella of TÜBİTAK Marmara Research Centre (TÜBİTAK MAM KARE) was established in 2019. This institute has organized seven Turkish Antarctic Expeditions (TAE) and three Turkish Arctic Science Expeditions (TASE). TÜBİTAK MAM KARE has also provided opportunities for Turkish researchers and their international collaborators in various disciplines (e.g., Earth Sciences, Life and Physical Sciences, Social and Human Sciences) to conduct research in Antarctica and the Arctic, totaling 66 projects. This has reinforced Türkiye's role in these regions. As a young institute, TÜBİTAK MAM KARE has made significant progress to date, and much more is expected in the near future as climate change studies become increasingly crucial. Earth Sciences play a critical role in this context, aiding in a better understanding of the past and future evolution of these remote and pristine regions.

Our scientific expeditions to the Arctic region (TASE) have facilitated a range of onboard scientific explorations, such as physical measurements of seawater and sediment sampling. Additionally, a temporary scientific base established at Horseshoe Island (Marguerite Bay, Antarctic Peninsula), the main destination of TAE, supports both onboard and on-land studies. This base is equipped with several measurement instruments, including the Global Navigation Satellite System, an automatic weathering station, and a low-cost seismograph, enabling comprehensive environmental and geological monitoring. The recent accession of Türkiye to the Spitsbergen/Svalbard Treaty, coupled with our ongoing initiatives to develop a more equipped scientific camp on Horseshoe Island, is poised to significantly enhance the scope and depth of scientific research conducted by Turkish researchers in both the Arctic and Antarctic regions.

This special issue, titled "Advances in Earth Sciences: enhancing our understanding of Polar Regions," stands as an initiative to honor and remember five decades of contributions by Turkish researchers in the Polar Regions, especially dedicated to the memory and legacy of Atok Karaali.

In this special issue of Polar Sciences, we present a comprehensive overview of diverse, interconnected research projects in the Antarctic Peninsula (Figure 1A). The studies encompass a range of scientific disciplines and methodologies. Özyurt et al. (2023) investigate the geochemistry of lake sediments on Robert Island (Figure 1B), revealing insights into local weathering processes and sedimentary contributions. This research is intricately linked to the exploration of volcanic rock formations and mineralogical transformations on the same island (Kandemir et al., 2023). Karaođlan et al. (2023) extend this geological discourse by examining the magmatic and tectonic history of Dismal Island (Figure 1C), bridging the understanding of regional geological developments.

Complementing these geological perspectives, Özkan's study (2023) on nutrient dynamics and primary productivity in Maritime Antarctic lakes offers critical insights into the biogeochemical processes in polar aquatic ecosystems affected by climate change. Advancing technological applications in polar research, Selbesoğlu et al. (2023a) demonstrate the efficiency of unmanned aerial vehicles combined with ground-penetrating radar for glacier surveys in Horseshoe Island (Figure 1C), while Selbesoğlu et al. (2023b) and Alkan et al. (2023) highlight the pivotal role of satellite-based techniques and GNSS (Global Navigation Satellite System) technologies in monitoring climatic and environmental changes in these remote regions.

An innovative approach by Gülnerman (2023) to crowdsourcing geodata in Antarctica highlights the potential of social media data in enhancing our understanding of this continent, and Şenel et al. (2023) emphasize the importance of a web-based GIS (Geographic Information System) in centralizing and disseminating polar data, fostering a collaborative and multidisciplinary approach to polar science research.

This special issue not only provides a holistic view of the current state of Antarctic research but also underscores the interconnectedness of geological, environmental, and technological studies in understanding and preserving one of Earth's most critical and sensitive regions.

We express our profound gratitude to all the authors for their invaluable contributions and to the reviewers for ensuring the rigor and quality of this issue. We also extend our special thanks to Prof. Dr. Orhan Tatar, the Editor-in-Chief of the Turkish Journal of Earth Sciences, for his unwavering support and guidance throughout the curation of this special issue.

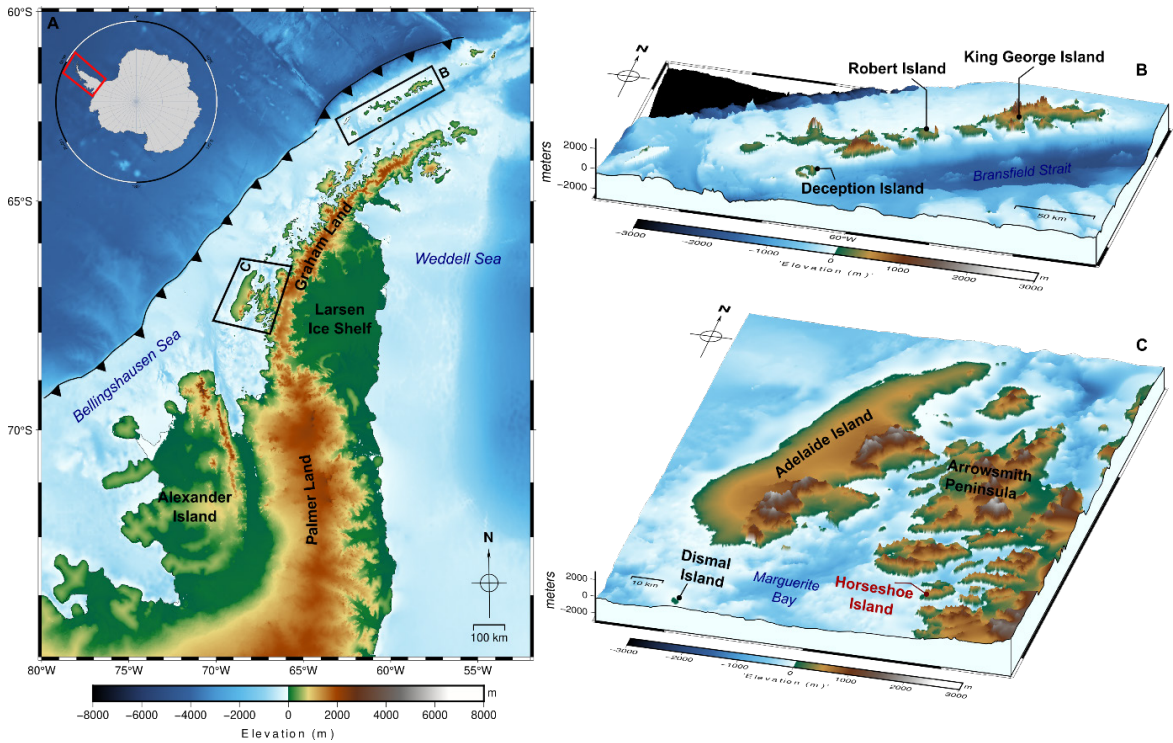


Figure 1. A. Colored digital elevation model (450 km resolution SRTM15+V2.5.5) displaying the surface topography and bathymetry of Antarctic Peninsula, along with the main trench between Phoenix and Antarctic Plates. B. and C. Close-up views of South Shetland Islands and Marguerite Bay regions.