

# **Advances in Military Geosciences**

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Eric V. McDonald • Thomas Bullard  
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# Military Geosciences and Desert Warfare

Past Lessons and Modern Challenges

 Springer

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# **Preface: Military Geosciences: Past Lessons and Modern Challenges**

Military activities—past, present, and in the future—will always be strongly integrated with a wide spectrum of geosciences. From providing the stone resources for primitive weapons to utilization of terrain in offensive and defensive strategies, warfare has had an intimate relationship with geology and terrain. The decisive outcomes of numerous battles on land throughout history have been dictated in large part by the terrain and environmental setting. Modern military operations rely on a wide range of land-, air-, sea-, and space-borne intelligence and knowledge of dynamic terrain processes and conditions. The modern study of geological-based environmental sciences is critical for both the sustainable management of military reservations and installations as well as evaluation of how the terrain and environmental conditions may impact military equipment and operations.

The study of the role of geology and geography in military affairs is not a recent phenomenon. The organized interest in meeting biennially to present and discuss things geologic and military, which since 2009 is known as the International Conference on Military Geosciences (ICMG), is, however, relatively new. The meaning of the term ‘geosciences’ by ICMG has evolved to include nearly all traditional research aspects of the fields of geology and geography as well as overlapping fields of hydrology, archeology, and history. During the general course of ICMG’s existence, from a GSA symposium held during the 1994 Geological Society of America Annual meeting in Seattle through a 5-day conference held in Las Vegas in 2011, there have been generally two topical themes. The first theme has been studies focused on how geologic and geographic settings have influenced both past military history, especially battles and campaigns of historical significance, and modern warfare and conflict in the twenty-first century. The second theme includes studies with an emphasis on the influence of geosciences, in particular surficial processes and landscape history, on environmental issues related to management and sustainability of military installations, environmental health and safety of military personnel, effective management of cultural resources, and environmental security (e.g., water resources, climate change). The second theme area also has seen an increasing use of remote sensing, digital elevation modeling, and numerical modeling in regards to military activities. The growing modern emphasis on environmental, natural, and cultural resources reflects changing global views and attitudes toward

the environment, which are not limited just to the battlefield, but also extend to peace-keeping operations, counter insurgency, and disaster recovery. Presentations related to environmental and cultural resources in recent years have shown geologic and terrain relevance to in-theater operations as well as environmental sustainability at installations with active training and testing programs.

This volume is the most recent contribution from a series of published conference proceedings that have evolved over the years since the first military geoscience meeting was convened in Seattle in 1994. Five previous volumes are based on papers presented at previous themed ICMG conferences, held under various conference names and sponsorships. Volumes represent military geoscience papers presented as part of symposium and conferences convened in Seattle (Underwood and Guth 1998), London (Rose and Nathanail 2000), Greenwich (Doyle and Bennett 2002), the U.S. Military Academy, West Point (Caldwell et al. 2005), Nottingham (Nathanail et al. 2008), and Vienna (Häusler and Mang 2011). Three other notable volumes that complement the ICMG series, Ehlen and Harmon (2001), Rose and Mather (2012), and Harmon et al. (2014), each contain a range papers on military geosciences presented at several other military geoscience-themed workshops, symposium, and conferences held in the United States and the United Kingdom.

This book contains twenty-two papers, the majority of which were presented at the 9th International Conference on Military Geosciences (ICMG) held in Las Vegas, Nevada (USA) from June 20 to June 24, 2011. The conference provided a venue for military personnel, academics, and practitioners from government service and commercial enterprises to explore a wide range of military geosciences. The overarching theme of the 2011 meeting in Las Vegas was the role of deserts in past and modern warfare, issues with management of military lands in desert regions, and how desert environmental conditions can impact military equipment and personnel. The program of oral and poster presentations contained a wide array of topics on how the desert landscape has impacted military history as well as providing unique challenges to the sustainability of military lands. Many of the papers presented in this book have a focus on desert terrain. All papers present examples of the role of geoscience to add clarity about how the basic nature of landscapes and geomorphic processes have influence the outcomes of past battles to the modern challenges of integrating geoscience into a wide range of military activities. Many of the modern challenges extend well beyond the battlefield and commonly include developing strategies to increase environmental sustainability of military installations to numerical modeling of complex terrestrial processes.

This book is divided into three parts each reflecting a different theme of military geosciences. Part I: *Geoscience and Military History Military Geosciences: Past Lessons and Modern Challenges* (Chaps. 1–7) presents a series of papers that combine geoscience with a wide range of military history and terrain attributes. Papers include military campaigns or activities that occurred in the desert or dryland settings of Gallipoli (Turkey), Arizona, California, and eastern Washington state (U.S.) and Tunisia, and more humid settings in the U.S at Gettysburg (Pennsylvania) and coastal North Carolina. These papers integrate a combination of terrain analysis, Geographical Information System (GIS) methods, and digital photography to exam-

ine linkages between landscape history, geology, and military history. Part II: *Military and Defense Interests and the Environment* (Chaps. 8–16) contains nine papers that examine the linkage between military and defense interests and related environmental impacts and resource needs. Several papers in this section include environmental impacts from military activities related to uranium in the environment, growth and sustainability of military infrastructure, and environmental awareness by military personnel. Papers in this section also examine a range of environmental security issues including trans-border water issues, geographic controls on forward operating bases, distribution of dust-rich soils, and agricultural development teams in southwest Asia in support of recent military activities. Part III: *Geoscience Technology in Support of Military Activities* (Chaps. 17–22) presents papers that examine the development and application of recent geoscience technology in support of modern military activities. Papers include the use of remote sensing information, including digital elevation models, Aster imagery, and multispectral imagery, for the characterization of terrain in support of military operations. Papers in this section also include military aspects of direct measurement of soil surface properties including use of ground-based lidar for detection of IED command wires, training future Army officers on collecting ground mobility data, and examples of how agricultural soils impact tank mobility.

In addition to the participants, many people contributed to the development of this volume. First we would like to thank the nearly forty scientists and military professionals who reviewed the chapters in this volume (each paper underwent peer-review by two anonymous reviewers); including several reviewers who handled multiple papers. Nearly all of the reviewers have participated in past military geoscience conferences and their knowledge of military history and science promoted and encouraged a high level of academic quality of the papers. We also thank Ron Doering (Springer Science) whose encouraging patience persisted throughout the time required to complete this volume. Finally we want to acknowledge and sincerely thank Marie Dennis (DRI/UNR) who assisted with tracking manuscripts and reviews and Sophie Baker (DRI) who was responsible for the seemingly, never ending task of working all papers, figures, and tables into the proper format in order to bring this volume to a successful conclusion, we are forever grateful.

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