

GEOMORPHOLOGY OF DESERT DUNES

Sand dunes are a globally important depositional landform and sedimentary system. Their origins and dynamics are important in understanding how deserts have evolved in response to climate change and changes in sand supply and mobility, and how they will continue to evolve in the future. This book provides a state-of-the-art review of the characteristics of desert dunes and their sediments, and explores their dynamics on timescales from days to millennia as they respond to changes in wind speed and direction, precipitation and sand supply. This extensively revised edition reflects the advances in our understanding of desert dunes, their dynamics and history; and covers recent developments including the luminescence dating revolution, ground penetrating radar and advances in numerical modeling. Also covering dunes on Mars and Titan, this authoritative reference is a must-have for researchers and graduate students working on desert dunes and aeolian geomorphology.

NICHOLAS LANCASTER is a leading expert on desert sand dunes, and Emeritus Research Professor from the Desert Research Institute, USA. He has worked on desert dunes in Africa (Namib, Kalahari, northern and western Sahara), Arabia, Antarctica, and the western United States (Mojave and Sonoran Deserts). His research focuses on dune dynamics and morphology, the application of remote sensing, ground penetrating radar and optical dating, and the impacts of climate change on desert regions. He has won multiple awards including the Farouk El-Baz Award from the Quaternary Geology and Geomorphology Division of the Geological Society of America (2001), the NSHE Regent's Researcher Award (2007), and the Liu Tungshen Medal from the International Quaternary Association (INQUA, 2019).

‘Studying desert dunes continues to be essential to our understanding of the geomorphology and climate of Earth and other worlds in the solar system. The update to this anchoring text seamlessly merges the significant advancements in aeolian science over the past few decades with core concepts from decades prior. This book will serve as the go-to source for any scientist needing a reference for wind-blown sand dunes and as the textbook for training the next generation of aeolian scientists.’

Professor Ryan Ewing, Texas A&M University

‘Nick Lancaster’s fifty-plus years of field research on desert dunes and his keen insights on the ‘big-picture’ of dune formation and change make him the best qualified person to write the definitive book on the subject. This thoroughly revised and updated second edition is a must-read for anyone seeking to understand desert sand dunes.’

Jeff Lee, Department of Economics and Geography, Texas Tech University

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Desert Research Institute



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Preface to the Second Edition

The original version of *Geomorphology of Desert Dunes* was published in 1995. The content reflected concepts and examples existing in the early 1990s. At this time, it was possible for an individual to comprehend the scope of the field and to be familiar with the key concepts and studies. This is no longer the case, as the number of articles published in the field of aeolian science has increased exponentially in the last three decades and the diversity and complexity of approaches has expanded considerably.

The first edition was published prior to many important developments in the field, which include, but are not limited to, (1) the luminescence dating revolution, enabling a chronology of periods of aeolian accumulation and dune formation in many areas, as well as assessment of rates of dune accumulation and movement; (2) the advent of ground penetrating radar, facilitating imaging of the sedimentary structures of dunes; (3) advances in technology, facilitating more-detailed measurements of winds and sand transport on dunes, and their relationships to the formation and dynamics of desert dunes; (4) studies of the mineralogy and provenance of dune sand using geochemical, isotopic, and remote sensing approaches; and (5) numerical modeling of dune processes and dynamics. The insights gained by these new approaches have enabled greater understanding of the dynamics of desert dune systems on different timescales, but also have posed many new questions to be addressed by field studies and numerical modeling. In many cases, modeling of processes and forms has resulted in new insights but has also greatly exceeded the ability to test the models in the field.

The geographical range and diversity of investigations has expanded dramatically, with important contributions from new areas, especially from Chinese scientists. Numerical modeling has engaged a new community of investigators from backgrounds in physics and numerical methods, in addition to traditional fields of geomorphology.

This new edition has been extensively revised to reflect the advances in the understanding of desert dune processes, dynamics, and history that have taken place over the past three decades, building on the work discussed in the original edition. As before, the content and approach of this book reflect my experience in dune fields and sand seas in different desert regions.

Organization of This Book

This book is organized into seven main parts, each focusing on a specific aspect of the geomorphology of desert dunes. Part II discusses the characteristics of dunes and their morphology and sediments; Part III provides a review of sand transport processes as an introduction to a discussion of dune dynamics; Part IV focuses on the boundary conditions that determine dune morphology and the response of dune systems to changes in boundary conditions; Part V considers aeolian sand bodies (dune fields and sand seas) as the depositional sink for the dune system; Part VI discusses how dune systems have developed in time (including ancient aeolian sandstones) and space (planetary dune systems); Part VII is a review of the field and offers some ideas about the future of desert dune studies.

Acknowledgments

It has been my privilege to be able to devote my career to the study of desert dunes, to be able to travel to and live in different parts of the world, and to truly experience the beauty and magic of dune landscapes.

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In production of this book, I want to acknowledge Sarah Lambert, my editor, and Cambridge University Press for their support and patience; and my wife, Maria Tinangon, for putting up with me while I devoted time to writing when I could have been doing other things.