MARS: AN INTRODUCTION TO ITS INTERIOR, SURFACE AND ATMOSPHERE

Our knowledge of Mars has changed dramatically in the past 40 years due to the wealth of information provided by Earth-based and orbiting telescopes, and spacecraft investigations. Recent observations suggest that water has played a major role in the climatic and geologic history of the planet. This textbook covers our current understanding of the planet's formation, geology, atmosphere, interior, surface properties, and potential for life.

This interdisciplinary textbook encompasses the fields of geology, chemistry, atmospheric sciences, geophysics, and astronomy. Each chapter introduces the necessary background information to help the non-specialist understand the topics explored. It includes results from missions through 2006, including the latest insights from Mars Express and the Mars Exploration Rovers.

Containing the most up-to-date information on Mars, this textbook is essential reading for graduate courses and an important reference for researchers.

NADINE BARLOW is Associate Professor in the Department of Physics and Astronomy at Northern Arizona University. Her research focuses on Martian impact craters and what they can tell us about the distribution of subsurface water and ice reservoirs.

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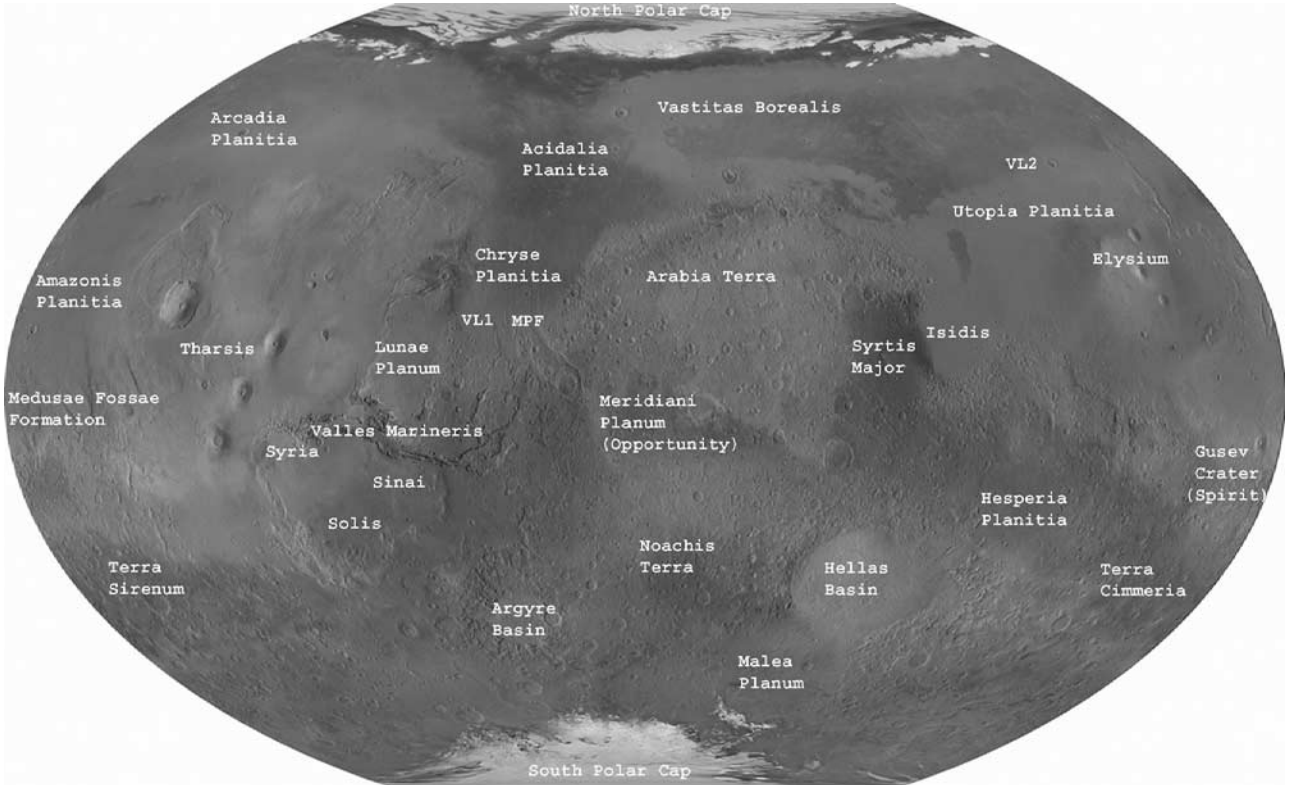

Shaded relief map of Mars showing the locations of major features discussed in the text. Landing sites of the two Viking Landers (VL1 and VL2), Mars Pathfinder (MPF), and the two Mars Exploration Rovers (Spirit and Opportunity) are also shown. (Shaded relief map courtesy of National Geographic Society/MOLA Science Team/Malin Space Science Systems (MSSS)/NASA/JPL)

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Contents

Preface

It is an exciting time to be a planetary scientist specializing in Mars research. I have had the privilege of experiencing our changing views of Mars since the beginning of space missions to our neighbor. Mariners 6 and 7 flew by the planet shortly after I became interested in astronomy at age 10. I checked the news every day when Mariner 9 began to reveal the geologic diversity of Mars. The Viking missions started their explorations as I was entering college and the Viking 1 lander ceased operations just as I was starting to utilize the orbiter data in my Ph.D. thesis. Over the subsequent years I grieved the lost missions and cheered the successful ones. I feel extremely fortunate to be able to work in such an exciting field and contribute to our expanding knowledge of the planet and its history.

I have taught graduate courses about Mars at the University of Houston Clear Lake, University of Central Florida, and Northern Arizona University. The 1992 University of Arizona Press book *Mars* is the best compilation of our knowledge through the Viking missions, but has become increasingly deficient as Mars Pathfinder, Mars Global Surveyor, Mars Odyssey, Mars Express, and the Mars Exploration Rovers have revealed new facets of Mars' evolution. A few years ago I developed a course pack for my students which I updated prior to each term when I taught the course. This book is an expanded version of that course pack and is appropriate for graduate students in planetary science, professional scientists, and advanced undergraduate science majors.

Mars: An Introduction to its Interior, Surface and Atmosphere focuses on what we have learned about Mars since 1992. I have had no delusions that I could replicate the excellent detailed summaries provided by the experts in the 1992 *Mars* book. What I have endeavored to do is to expand upon that treatise by summarizing the latest discoveries and how they are once again changing our paradigm of Mars.

The study of Mars is a very interdisciplinary science, covering sciences as diverse as geology, geophysics, geochemistry, atmospheric dynamics, and biology.

Mars researchers specialize in a specific discipline and can have difficulty understanding the other aspects of Mars studies. I have taught my graduate level Mars class to geology, physics, astronomy, and engineering students and have seen how they struggle with material outside of their discipline. I have therefore structured this book to include enough background material so someone from another discipline can understand and appreciate the advances made in other fields. I assume the reader has sufficient background to understand basic geology terms, calculus-based introductory physics, and mathematics through differential equations. However, it is impossible to provide detailed coverage of every aspect of Mars research in such a book. I have therefore provided an extensive reference list and encourage the reader whose interest is piqued by a particular topic to explore the original literature. I apologize in advance to my colleagues who find some of their works not included in the references. The Mars literature is voluminous and I have attempted to provide a reasonable sampling of the articles and books which cover the currently accepted views of the planet and some of the ongoing debates.

It is difficult to write a book like this while so many Mars missions are still operating. Several times I thought I had completed a specific chapter only to go back later and revise it as new discoveries were announced. Therefore the reader needs to recognize that the book includes information only through the end of 2006. I fully expect that results from the recently arrived Mars Reconnaissance Orbiter together with new discoveries by Odyssey, Mars Express, Spirit, and Opportunity will make some of the discussion in this book obsolete very soon. We are obviously in the golden age of Mars exploration, but now is a good time to step back and summarize the dramatic shift in our view of Mars produced during the past ten years of spacecraft and telescopic observations.

This book would not have been possible without the input and support of many people. My mother Marcella, my late father Nathan, and my sister Lynn have provided love and support throughout the years, even when they probably thought I was crazy for being such a Mars fanatic. I also appreciate all my friends and family who are not scientists but who have always shown great interest in the work that I do. I have had many wonderful professors who have inspired me and would like to specifically acknowledge the mentorship of James Pesavento and Robert Strom. My colleagues at Northern Arizona University have been a great support system and I especially acknowledge Dean Laura Huenneke and chairs Tim Porter and David Cornelison who encouraged me to undertake this project even when I was not yet tenured. The staff at Cambridge University Press has been a joy to work with and I want to thank Helen Goldrein for her patience and encouragement. Finally, this book would not have been possible without the work of my friends and colleagues in the Mars community. Here's to many more years of exciting discoveries!