

Skin-deep observations with profound implications

Planetary Surface Processes

H. Jay Melosh

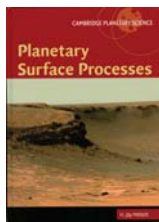
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Reviewed by J. Taylor Perron

The NASA rover, Curiosity, which is currently traversing the Martian surface, is emblematic of the renaissance in planetary exploration that began in the 1990s. Recent spacecraft missions, like those of the cold war era, have brought a flood of new insights about planetary surfaces, the easiest part of a planetary body to observe, and in many ways the most charismatic.



That deluge of data has come at a time when the study of Earth's surface has grown increasingly quantitative. The opportunity to apply terrestrial theory to analogous planetary settings is an exciting prospect for the terrestrial geologist who is unable to perform field experiments within a geologically meaningful time interval. Also, planetary landscapes have offered up unexpected and occasionally baffling phenomena that are forcing students of Earth's surface to expand their perspective on what defines a landscape and how a planet's surface evolves over time.

For those reasons, H. Jay Melosh's *Planetary Surface Processes* is a timely contribution. The book is an expanded, formalized version of a popular course taught for more than two decades by the author, one of the foremost statesmen of planetary tectonics and impact cratering. The front matter sets the ambitious goal of providing an overview of "the full range of geological processes that shape the surfaces of planetary-scale bodies." The ensuing text manages to deliver on that promise

while maintaining a jocular tone that makes it engaging without sacrificing quantitative rigor.

It would be easy to fill a volume with a catalog of the varied observations returned by spacecraft missions. But make no mistake: *Planetary Surface Processes* is not a bestiary of planetary landforms. Rather, it is a summary of many years of progress in geology and geophysics that is organized by physical process and interspersed with examples of quantitative, often comparative planetary applications. The book is peppered with historical anecdotes such as those relating G. K. Gilbert's ambitious flume experiments at the University of California, Berkeley, and the initial disappointment over the Moon-like appearance of Mercury's surface observed during the *Mariner 10* mission.

Following a brief tour of the solar system and the planetary surfaces that have attracted the most exploration and attention, the book continues with a chapter on planetary shape and large-scale topography. It then proceeds to describe physical processes of progressively finer scale and rarer occurrence. The book truly shines in the middle chapters on material strength and topography, tectonics, and impact cratering, the subjects on which the author's own research has made indelible marks. Volcanism is naturally also included among the most widely observed processes. The chapter on regoliths and weathering signals the transition from large-scale to finer-scale processes that modify surfaces. Experts may notice the relatively concise treatment of topics, such as fluvial processes, that have received a large share of attention in the literature. This is, after all, a text about all the terrestrial and icy bodies; rivers, while fascinating, are relatively rare in the solar system. Nonetheless, the closing chapters on mass movement, wind, liquid water, and ice cover the essential principles that mission scientists are using to interpret what Curiosity sees near its landing site in Mars's Gale Crater.

Planetary Surface Processes is aimed at advanced undergraduates, beginning graduate students, and planetary scientists working outside their immediate specialty who need a quick introduc-

tion or refresher. Even for those who do not need a primer, the book will function as a useful reference. Each chapter provides an annotated list of suggestions for further reading, though a few passages in the text would have benefited from additional references to the literature they summarize. For example, the explanation in chapter 10 of the work performed on a landscape by a distribution of floods could direct readers either to the classic 1960 paper by M. Gordon Wolman and John Miller or to more recent reviews that provide an entry point into the literature. Solutions to end-of-chapter exercises are left to the reader; that should not pose much of a problem for course instructors, but it may challenge students working independently of an organized course.

This book overlaps little with existing texts, such as Imke de Pater and Jack Lissauer's *Planetary Sciences* (2nd edition, Cambridge University Press, 2010), which covers a wider range of phenomena and provides an advanced introduction to planetary science. But as the first systematic, quantitative treatment of its subject matter at an introductory level, *Planetary Surface Processes* is poised to become the standard text for planetary surface geology and will make an essential addition to the bookshelves of students and researchers alike.

Scale Invariance From Phase Transitions to Turbulence

Annick Lesne and Michel Laguës
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The remarkable scale invariance exhibited in many objects and processes has profound implications for numerous problems in modern physics and on the analytical methods used to solve those problems. In *Scale Invariance: From Phase Transitions to Turbulence*, Annick Lesne and Michel Laguës show how scale invariance is exhibited in such physical processes as diffusion, turbulence, and superconductivity and in such systems as polymer solutions. That

