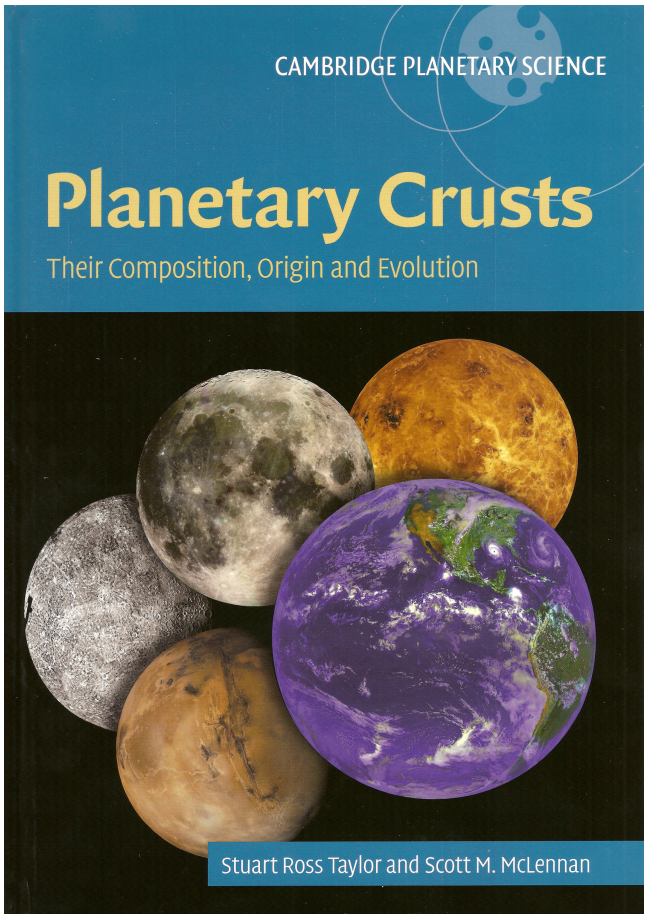
The Meteoritical Society

Meteoritics & Planetary Science 44, Nr 3, 465–466 (2009)
http://meteoritics.org

Book Review

Planetary crusts: Their composition, origin and evolution, by Stuart Ross Taylor and Scott M. McLennan, Cambridge University Press, 2009, 400 p., $70, hardback, (ISBN 978-0-521-84186-3).



Crust formation is fundamental to the evolution of planets, hence the intense efforts to understand the associated processes, and the correspondingly vast and growing literature on planetary crustal diversity. However, a comprehensive, easy-to-read reference on planetary crusts to introduce students and scientists alike to the mesmerizing crustal diversity in our solar system has been sorely lacking. It is therefore a pleasure to review the recently published *Planetary crusts: Their composition, origin and evolution* by Ross Taylor and Scott McLennan. These experienced scientists specialize in both terrestrial and extraterrestrial crustal processes and offer a book on the outer shells of planets that is both insightful and a pleasure to read.

Taylor and McLennan intend their book to be "an enquiry into the problem of how and why solid planets produce crusts." Concise chapters cover the subject from relatively simplistic formation of primary anorthositic crust on the Moon to the immense complexity of terrestrial continental crust formation, presenting mainly geochemical, geophysical, and geological arguments. It is entertaining and refreshing to read their opinions on current controversies regarding crust formation processes; the only instance where they prevaricate is over the existence of mantle plumes and their influence on crustal processes on Earth.

The book is a pleasure to read; the writing style is fluid and extensive references are presented at the end of each chapter, listed numerically. This allows readers to explore the nuances of arguments developed in the book without disrupting the overall tenor of individual chapters. The authors also offer a useful synopsis at the end of each chapter.

The book starts with a helpful summary of planetary differentiation and formation processes, factors ultimately responsible for crust formation. The authors conclude that, unlike stars, planets and their crusts cannot be "pigeon-holed" into a unifying classification scheme, but instead are unique. Chapter 2 considers an example of "primary" crust, the highland anorthosites of the Moon. This crust, considered to have originated via plagioclase floatation during lunar magma ocean differentiation, offers an example of early "original" crust that is so conspicuously absent for Earth. Chapter 3 follows with generation of "secondary" lunar crust, where mare basalts erupted forming a local and thin veneer of crust hundreds of millions of years after primary crust formation.

Chapter 4 considers what little is currently known about the state of Mercury's crust. A great deal is likely to be revealed by MESSENGER, but this book offers a useful start to those interested in our fleet-footed planetary neighbor. Like the Moon, Mars receives two chapters (5 and 6) in the book, the first considering the composition and differentiation of Mars and the second considering its crust. As with Mercury, our knowledge of crust formation processes on Venus is limited, but nevertheless the authors offer a valuable account of the likelihood of complete resurfacing processes on Earth's "twin" in Chapter 7.

Nearly a third of the book is devoted to Earth's crust, a reflection of what is known about continental crust formation and of the author's considerable investment in this subject area. The reader is led through the composition, origin, and

evolution of the oceanic crust (chapter 8), what little is known about the Hadean crust (chapter 9), the Archean crust (chapter 10), the post-Archean continental crust (chapter 11), and finally the composition and evolution of the "Tertiary" continental crust (chapter 12). Perhaps most intriguing is the authors' opinions on the nature of Hadean crust, when plate tectonics began on Earth, and the revival of the "andesite model" of continental crust formation.

The final two chapters are devoted to crusts on minor bodies and the authors' reflections on their considerable journey unraveling planetary crust complexities. Chapter 13 considers asteroid crust formation, including 4 Vesta, and the crusts of Galilean and other planetary satellite moons. It serves as a reminder that not all planetary crusts are "rocky" and that startling diversity is preserved in the icy crusts of Europa, Ganymede, and Callisto. Who knows what possibilities await, within the boundaries of physical laws, regarding crust compositions from other worlds? The last chapter, "Reflections: The elusive pattern of planetary crusts," offers a personal account of planetary crusts, and this chapter alone is worth reading for the caveats, cautions, and complexities of crust composition, origin, and evolution.

Relevant scientific literature is considered up until 2007 which, as ever, results in a somewhat historical quality to some arguments. For example, the Moon is considered essentially "bone dry," whereas the latest measurements of lunar volcanic glasses imply the presence of water in the lunar mantle. Similarly, recent arguments relating to Martian crustal dichotomy via impact, magnetic variations in the southern Martian crust through deformation, insight into Mercury's crust from the MESSENGER mission, and evidence suggesting some asteroids generated evolved felsic crust are absent. However, there are very few such omissions making the book all the more impressive given the breadth of subject matter covered.

A major theme is to seek answers related to the origin and evolution of planetary crusts. The authors conclude that "there are more variables than there are planets" in crust formation processes and that, within physical laws, crust formation is an inherently stochastic process. To some this may be sobering, but to many this will further illustrate why studies of planetary crusts are essential, most especially since the formation of Earth's own continental crust seems inextricably linked with the rise of our own species. Indeed, studies of planetary crusts inspire and enlighten, exemplified by the Apollo landings and by more recent planetary flybys by unmanned spacecraft.

In conclusion, *Planetary crusts: Their composition, origin and evolution* is a well-written and researched book that would complement the library of any crustal scientist, graduate-level student studying planets, or a person curious as to how planets and their crusts came about. Whether this book graces as many personal libraries as it should will depend on the current trend for science publishers to price such books outside of the acceptable costs for most individuals.

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