

## BOOK REVIEW

**Book Review: *Geochronology and Thermochronology*. (2018)**

By Peter W. Reiners, Richard W. Carlson, Paul R. Renne, Kari M. Cooper, Darryl E. Granger, Noah M. McLean, and Blair Schoene. Wiley/American Geophysical Union. ISBN 978-1-118-45585-2, 480 pages. \$156 Hardcover.

The discipline of geochronology and thermochronology is as extensive as it is specialized, with numerous decay systems that can be applied to vast array of geological questions, from constraining the formation of the solar system, to assessing Quaternary erosion rates. This text, *Geochronology and Thermochronology* by Reiners et al. (2018), does an excellent job of explaining and communicating this complex and ever-changing subject. Breaking it down into concise and understandable chapters that focus on the theory, analytical methods, and applications to specific geological questions and processes, using real-world examples from contemporary and seminal research. Chapters 1 and 2 of this text give the reader a welcome introduction and historical perspective to geochronology, with the obligatory touch of nuclear physics. These opening chapters describe how the early pioneers in the field changed our understanding of the age of earth, and how the development of radioisotope geochronology has fundamentally influenced the study of geology throughout the 20th and 21st centuries.

Chapters 3 through 5 explain analytical and laboratory methods as well as geochronological and thermochronological data reduction and interpretation, which is just as crucial a process to understand. It is customary for geochronology textbooks to give detailed descriptions on the basics of sample selection, preparation, and the mass spectrometry techniques employed during geochronology and thermochronology, and this textbook is no different. However, the authors treatment of the standard material diverges from its predecessors in their discussion on the topic of data reduction and interpretation techniques, which is currently a hot topic in the interpretation of geochronological results and what is geologically significant of the obtained age. Rapid advancements in mass spectrometry methods over the past decades have allowed for rapid acquisition of large geochronological datasets which can be overwhelming to process and interpret; therefore, having a strong foundation in data reduction and interpretation techniques is crucial for any geochronologist.

The majority of this text, chapters 6 through 14, describes the basic concepts and common applications of the widely used geochronological and thermochronological techniques of Rb-Sr, Sm-Nd, Lu-Hf, Re-Pt-Os, U-Th-Pb, Ar/Ar, and cosmogenic nuclides. It even touches upon extinct radionuclides chronology, which has become an increasingly popular field of

isotope geochemistry with its unique applications to astrochronology and early Earth processes. In chapter 6, the authors combine the widely used chronometers of Rb/Sr, Sm/Nd, and Lu/Hf into a single 24-page chapter. For the layperson this is a fine treatment of these systems; however, for graduate-level research I find the descriptions of these systems to be less than ideal and on occasion the parallel nature of this chapter was slightly confusing. Each of these systems has a rich history and is applied to many different aspects of geochronology, I would have liked to have seen each of these radioisotope systems in their own chapter, but perhaps this is because of my research experience using the Sm-Nd system. Even so, the chapter does highlight the methods and major applications of these decay schemes.

Of the seven chapters that represent the bulk of this text, four of them in one way or another deal with the U-Th-Pb-He system. This is for good reason, since the multiple decay schemes associated with the isotopes  $^{238}\text{U}$ ,  $^{235}\text{U}$ , and  $^{232}\text{Th}$  have applications in almost every discipline of the Earth sciences. Given this utility, a strong foundation in the tenets of the U-Th-Pb system is paramount to understanding its applications to real-world geologic questions. The authors' treatment of this system is, by far, the most extensive and detailed, which is perhaps no surprise given the expertise of many of the authors. In chapter 8, "U-Th-Pb geochronology and thermochronology," the authors include excellent detail on the background and fundamentals of the system. This chapter was vital for me while I was preparing for my Ph.D. preliminary exam and I considered it an excellent reference for studying the principles of U-Pb zircon geochronology, for a radioisotope class I am currently taking. Although the chapter focuses on the systematics of the U-Pb in zircon, the authors mention and describe many other common minerals that can be dated using this system.

*Geochronology and Thermochronology* is an excellent textbook that delivers on the difficult balance between having an appropriate level of detail to be useful for an upper undergraduate to graduate-level class or research reference text without being too esoteric for a more general audience, with content and descriptions that are understandable and enlightening to the non-specialist. I would recommend this textbook for anyone interested in the history, principles, and mechanics of geochronology and thermochronology.

THOMAS FARRELL  
Geoscience Department  
Boise State University  
Boise, Idaho, U.S.A.