

## BOOK REVIEW

**Book Review: *Advances in  $^{40}\text{Ar}/^{39}\text{Ar}$  Dating: From Archaeology to Planetary Sciences*.** Edited by F. Jourdan, D.F. Mark, and C. Verati. Geological Society of London Special Publications. ISBN: 978-1-86239-360-8, 378 pages.

The recently published book *Advances in  $^{40}\text{Ar}/^{39}\text{Ar}$  Dating: From Archaeology to Planetary Sciences* is a collection of 24 chapters authored by international scientists on topics ranging from decay constants to  $^{40}\text{Ar}/^{39}\text{Ar}$  dating of extraterrestrial objects. As stated by the editors in their introduction, these chapters were assembled with the goal of providing technique-specific examples highlighting recent advances in the field of  $^{40}\text{Ar}/^{39}\text{Ar}$  dating. As this is the first book truly dedicated to  $^{40}\text{Ar}/^{39}\text{Ar}$  dating since the second edition printing of the argon geochronologist's handbook *Geochronology and Thermochronology by the  $^{40}\text{Ar}/^{39}\text{Ar}$  Method* (McDougall and Harrison 1999), a new collection of chapters highlighting recent advances in  $^{40}\text{Ar}/^{39}\text{Ar}$  geochronology offers much to the interested reader.

The book is organized into four sections: methodological developments, tectonics, volcanology, and planetary sciences. Of particular note is a succinct perspective on the  $^{40}\text{Ar}/^{39}\text{Ar}$  method by Ian McDougall, one of the pioneers of  $^{40}\text{Ar}/^{39}\text{Ar}$  geochronology (Note: this should be required reading for any undergraduate or graduate class covering  $^{40}\text{Ar}/^{39}\text{Ar}$ ). Case studies on  $^{40}\text{Ar}/^{39}\text{Ar}$  systematics of lunar and meteorite samples, echo the historical roots of this invaluable isotopic dating method. These roots were firmly established by a seminal paper by Merrihue and Turner (1969), and if history is any guide the chapter describing argon isotopes as geochemical tracers (by Turner and Burgess) will be similarly prescient.

The section on methodological developments represents the core of the book's new "advances" in  $^{40}\text{Ar}/^{39}\text{Ar}$  methods. This section includes topical discussions on the uncertainties in quantifying K-decay, what does and does not qualify as a neutron flux monitor, the status of thermal histories modeled from laboratory degassing of argon in K-feldspar and white mica, new data on argon diffusion and solubility in plagioclase, effects of argon recoil and alteration, and details of a laser heating method. The tectonics section contains contributions that provide new data and insight into  $^{40}\text{Ar}/^{39}\text{Ar}$  dating of polyhalite and the diffusion of argon in alkali feldspar, but otherwise includes chapters with conventional applications of  $^{40}\text{Ar}/^{39}\text{Ar}$  data in different geographic areas, as is mostly done in the two chapters comprising the volcanology section. The final section contains four chapters that describe the difficulties of interpreting  $^{40}\text{Ar}/^{39}\text{Ar}$  dating of a variety of extraterrestrial matter, especially martian meteorites, and the necessity of sample characterization and sub-grain analyses in acquiring meaningful data.

Given the title of the book, it is regrettable that no study was included highlighting advantages of argon isotopic mea-

surement with past and present multi-collector gas-source mass spectrometers. Several several published studies leave little doubt that these instruments will continue to play a significant role in future advances in  $^{40}\text{Ar}/^{39}\text{Ar}$  research. A chapter or two addressing how these instruments improve ability to precisely resolve small isotopic differences, such as is the case with young (basaltic) volcanism or by in situ UV laser ablation, would have provided a nice complement to the book. Nonetheless, the real strength of this book lies in the overall scientific quality of the chapters and diversity of the subject matter: current debates about standardization, resolution of isotopic variation and gradients at the sub-grain level, modeling argon retention during cooling, mineral growth, alteration, and resetting. These are all research topics that collectively underscore the fundamental utility of the  $^{40}\text{Ar}/^{39}\text{Ar}$  method.

A significant accomplishment of this book is that it assembles chapters highlighting prevalent, and, in cases, contrasting, views of how  $^{40}\text{Ar}/^{39}\text{Ar}$  data are acquired, modeled, and/or interpreted. In addition, the chapters that highlight sub-grain sample characterization and analysis provide a glimpse into research directions that should be more accessible with improved technology. Although several of the chapters would have been improved by inclusion of summary data tables and better attention to the font size in some figures, the overall editorial quality of the chapters is quite good. For the most part enough novel material in this book makes it a useful reference. The sturdy binding and high-quality printing of the book are typical of what readers have come to expect from The Geological Society book series. This book should have no trouble finding a place on the shelf of any scientist interested in  $^{40}\text{Ar}/^{39}\text{Ar}$  methods.



### REFERENCES CITED

- McDougall, I., and Harrison, T.M. (1999) *Geochronology and Thermochronology by the  $^{40}\text{Ar}/^{39}\text{Ar}$  Method*, Second edition. Oxford University Press, 269 pp.  
Merrihue, C., and Turner, G. (1966) Potassium-Argon dating by activation with fast neutrons. *Journal of Geophysical Research*, 71, p. 2852–2857.

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