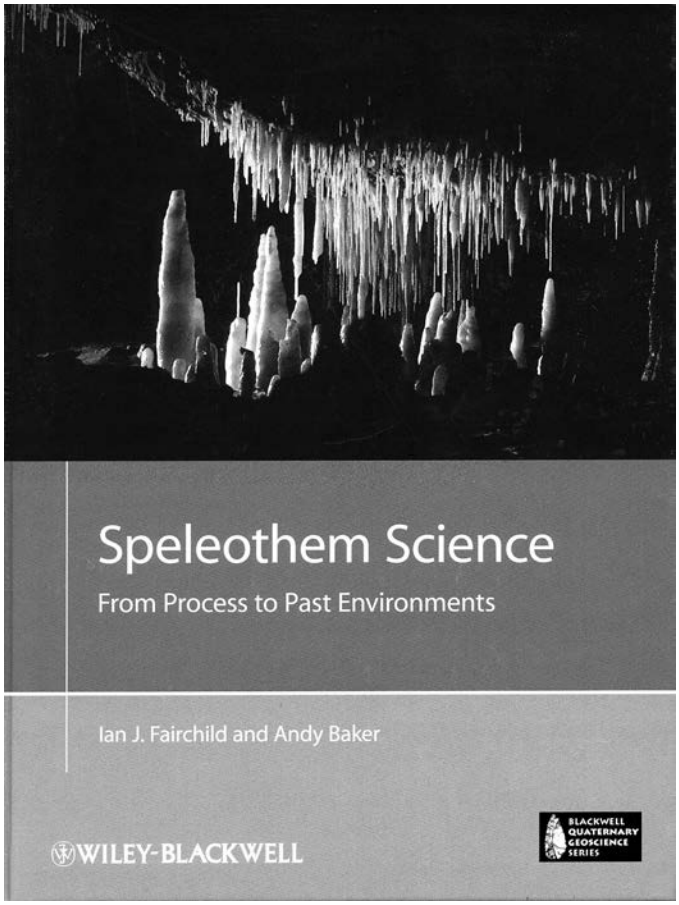
BOOK REVIEW



Speleothem Science: From Process to Past Environments

Ian J. Fairchild and Andy Baker, 2012, Chichester, UK, Wiley-Blackwell, 432 p., 7.5 × 10 inches, ISBN 978-1-4051-9620-8, hardcover, $119.95 (also available as e-book).

This is the first book to summarize in depth the concepts and methods of analyzing speleothems for their climatic record. Prior literature on the subject, though abundant, consists mainly of journal articles and occasional symposium volumes. This is such a rapidly growing field that it is a wonder that two of its most active researchers have been able to produce a book as detailed and comprehensive as this. Many speleologists find this an uncomfortable topic because it involves the harvesting of decorative cave features, often by researchers who give little thought to conservation. But one reason to welcome this book is that its authors are karst scientists who promote conservation through judicious field practices and meticulous archiving.

A brief review of the book's topics can barely scratch the surface: (1) The cave environment and speleothem growth, the concept of environmental systems, and systems analysis. Two new terms are coined: The *speleothem factory* refers to the system that supplies the raw ingredients for speleothems via the atmosphere, soil, and epikarst and transfers them to the cave environment. The *speleothem incubator* consists of aspects of the cave environment that regulate their growth, such as local variations in cave air, water flow, and chemistry. (2) The karst setting, including carbonate sedimentology and petrography, karst geology, and speleogenesis. (3) Surface conditions: climates, soils, and vegetation. (4) Physics of mass transfer, fluid flow, cave atmospheres, thermal processes, and evolution of dripwater along its flow paths. (5) Inorganic water chemistry, including stable isotopes. (6) Biogeochemistry and its influence on speleothems. (7) Speleothem shapes, patterns, crystal structures, and growth rates. (8) Speleothem growth and patterns, isotopic fractionation; (9) Sampling techniques and lab preparation. (10) Dating methods. (11) Interpretation of paleoenvironments, calibration techniques, validation of proxies. (12) Summary of results and relation to global climate patterns and orbital forcing. (13) An appendix on proper archiving of samples and the data obtained from them.

The authors clarify the different approaches for speleothem analysis according to the range of dates involved. Great attention is given to interpreting climate records over the past 500 years, which may at first seem strange because written records are already available for that time. But this overlap is crucial for calibrating speleothem data with real observations before they can be extrapolated to earlier climates or, once climatic patterns are better understood, into the future. Records from various climatic zones have now been calibrated against proxies such as the coral oxygen isotope record, tree rings, and cores of ocean sediment and glacial ice. There is strong emphasis on the Holocene because of its rich speleothem record and application to archeology. Because well-preserved ancient examples are rare and scattered, Pleistocene and older records receive relatively little coverage. This is a great challenge for the future in extending speleochronology into the realms of tectonic, sedimentary, and geomorphic history and paleokarst. Suggestions and caveats are offered for expanding this aspect of the field. Certain popular cave-dating methods, such as the use of cosmogenic radionuclides in cave sediment and argon dating of alunite generated by sulfuric acid, lie outside the scope of the book.

Technical subjects and laboratory techniques are covered in detail, and readers are guided through the maze with helpful chapter introductions, abundant sidebars, and lists of important questions. Guest authors have been enlisted to fill in relevant details such as speleogenesis. There are fifty pages of cited publications, as well as sixteen unnumbered pages of color photos and diagrams. Figures and tables in the book can be downloaded at www.wiley.com/go/fairchild/speleothem.

DOI: 10.4311/2013BR0102

This is essential reading for any new or prospective researcher in the field and a valuable resource even for those at the most advanced levels. Even those with only a casual interest in the field can gain a great deal of insight. The field is expanding so rapidly that the authors needed to complete the book quickly, while assimilating the ever-growing torrent of background material. Certain diagrams and terminology could use more clarification, and a few topics are described in more detail than necessary (e.g., petrology of carbonate rocks); but these are insignificant points in view of the overwhelming service this book provides. It will help those who genuinely need guidance and, one hopes, deter those who intend only to dabble. Those who consider caves to be clandestine and isolated places may be interested to learn how far speleology can be applied toward understanding the outside world.

Reviewed by Arthur N. Palmer and Margaret V. Palmer, 619 Winney Hill Road, Oneonta, NY 13820 (palmeran@oneonta.edu).