



## THE KARST SYSTEMS OF FLORIDA. UNDERSTANDING KARST IN A GEOLOGICALLY YOUNG TERRAIN

Sam Upchurch, Thomas M. Scott, Michael C. Alfieri, Beth Fratesi, and Thomas L. Dobecki, 2019, Springer, Cham, Switzerland, 479 p., 8.6 X 11.2 inches, hardbound \$189.00, ISBN 978-3-319-69634-8, e-book \$169.00, ISBN 978-3-319-69635-5.

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The Florida karst differs from most karst areas in the United States and throughout the world in that it is eogenetic—karst in geologically young limestone that is still undergoing diagenesis and consolidation, and has not been subject to deep burial and the effects of heat and pressure. Eogenetic karst, in contrast with telogenetic karst, has higher primary porosity, typically higher sinkhole density, and large springs. The authors list a number of persuasive reasons why the Florida karst should be of broad interest, including:

- The most extensive expanse of geologically young (Paleogene and younger), eogenetic karst in North America
- It includes two of the most productive aquifers in the world—the Floridan aquifer system and the Biscayne Aquifer
- Because of population pressure, it is an excellent laboratory for studying karstic aquifers under stress

- The landscape is remarkably flat, and
- It has been dramatically affected by sea level changes.

Because of the huge economic importance of the Florida karst (including a water supply and an engineering hazard as the result of sinkhole formation), it is appropriate that four of the five authors are from consulting firms. This is not to say the book lacks a strong academic focus—it doesn't lack it.

There are seven chapters. The first gives a general background, and the next two set the scene to the Florida karst—basic geology (chapter 2) and geomorphic characterization (chapter 3). Chapter two is noteworthy for its inclusion of extensive discussion of sediments, a topic not always found in books on karst. Of course, any karst region has a unique geological context and the authors do a good job in chapter three describing the components of the Florida Platform, with carbonate rocks ranging in age from the Cretaceous to the Pleistocene. As the authors caution readers, the terms highlands, lowlands, valleys, etc. must be seen in the context of a maximum land topographic relief of 105 m. Noteworthy are the very clear maps of physiographic provinces for each the karst geomorphic districts.

Chapters four and five focus on the water supply. In chapter four, after an overview of the factors influencing any hydrological cycle, the authors describe the three main aquifer systems in detail—the largely Pleistocene Surficial Aquifer System, including the Biscayne Aquifer, the Miocene Intermediate Aquifer System, and the older Floridan Aquifer System. A topic of particular interest in Florida is saltwater intrusion and the authors discuss the saltwater freshwater transition zone at length. Chapter five is really a continuation of chapter four and features both a general discussion of water quality trends and a detailed look at water quality trends aquifer by aquifer. The point out that water quality declines both because of land use activities and groundwater withdrawal.

Chapter six covers the controls on karst development, including denudation rates, fractures, time, depth, etc. The emphasis is on surface karst features, not surprising given their ubiquity and economic importance. The authors also describe the controls on karst landforms (e.g. fractures, epigenetic vs. hypogenetic development, time available).

Chapters seven and eight may be of most interest to speleologists. Chapter seven discusses cave development and sinkhole formation. The discussion of the mechanisms of sinkhole development and risk is especially thorough. They conclude that qualitative estimates of sinkhole development risk are good, but quantitative estimates are not. Much more problematic are his use of terms for karst features in mountainous terrains, especially poljes. There are a number of definitions of poljes (a Slavic word for field), but the strict definition is *a large, flat floored depression in karst limestone, whose long axis is developed parallel to major structural trends and can reach tens of kilometers in length.*

*Superficial deposits tend to accumulate on the floor.* (Field 2003). Anyone familiar with these very large landscape features first described from the Balkans, will be surprised to see features like Payne's Prairie described as a polje. It is surely a karst wetland and an intermittent lake, but if it is a polje, it is a very different type.

Chapter eight is a review of the major karst landforms found in Florida, including natural bridges, sandhill lakes, fluviokarst features (e.g., swallets and resurgences), karst escarpments, and somewhat uncommon features such as phytokarst and karren. The chapter (and the book) closes with a discussion of hypogene karst features. Hypogene karst is a very hot topic with some advocates, such as Alexander Klimchouk (Klimchouk et al. 2017) holding it to be of major importance). Even its definition is in dispute<sup>1</sup>, and the authors take a rather cautious approach in identifying hypogene karst features. They suggest that they can be found at the mixing zone of freshwater and saltwater, and in lower strata, but also point out there is little direct evidence for their existence.

The book is remarkably self-contained in the sense that one does not necessarily need a prior background in karst to read the book. Very fundamental concepts such as carbonate dissolution are covered, and there is extensive background material in the first three chapters. In this way it is reminiscent of the book, **Speleothem Science**. The authors have also attempted to make each chapter self-contained, with separate bibliographies for each chapter, presumably in response to the availability of pdfs of individual chapters from Springer, at a cost of \$29.95. While still expensive, it makes the book more accessible to more readers.

Overall the book is very well written, in generally accessible language. It is well illustrated throughout, both with photos and many excellent maps. There are always ways to make a book better, especially when one is not doing the writing. A glossary would have been nice, especially for the non-specialist. While the authors make a convincing case that the Florida karst is special and unique, a comparison with other areas with flat lying eogenetic karst, especially the Yucatan Peninsula of Mexico would have been interesting. Nevertheless, this volume belongs in the library of every karst researchers and at least the most relevant chapters should be in the library of students and young researchers.

This is among the first volumes about a U.S. cave system in the series of books on Cave and Karst Systems of the World, edited by James Lamoreaux.

## References:

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 Klimchouk, A., A.N. Palmer, J. De Waele, A.S. Auler, and P. Audra [eds.]. 2017. Hypogene and karst regions and caves of the world. Springer, Cham, Switzerland.