

# New Mexico Geological Society

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## ***Front Matter***

*(Usually includes Dedication, President's Message, & Conference Organizer's Message.)*

*in:*

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## **Annual NMGS Fall Field Conference Guidebooks**

Every fall since 1950, the New Mexico Geological Society (NMGS) has held an annual [Fall Field Conference](#) that explores some region of New Mexico (or surrounding states). Always well attended, these conferences provide a guidebook to participants. Besides detailed road logs, the guidebooks contain many well written, edited, and peer-reviewed geoscience papers. These books have set the national standard for geologic guidebooks and are an essential geologic reference for anyone working in or around New Mexico.

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# Caves and Karst of Southeastern New Mexico

Editors

Lewis Land  
Virgil W. Lueth  
William Raatz  
Penny Boston  
David L. Love



New Mexico Geological Society  
Fifty seventh Annual Field Conference  
September 21-24, 2006



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## DEDICATION

### CAROL A. HILL

With great pleasure, we dedicate this volume to geologist Carol Hill in recognition of her substantial and seminal body of work on the Guadalupe Mountains and their caves. During the last 35 years, she has been a major force in catalyzing interest in and study of this area.

Carol began caving in the Guadalupe Mountains after moving to Albuquerque in 1967 with her spouse, physicist Alan Hill and two young children. She began actively studying the mineralogy and geology of this area in 1970 concurrent with her graduate work at the University of New Mexico. An astute observer, Carol is known for her meticulous thoroughness. Her careful investigations have resulted in well over two hundred publications, but her work is far more than simply encyclopedic. Her broad understanding of Delaware Basin geology has made her 1996 PBS-SEPM publication the definitive work on the subject<sup>1</sup>.

In the speleological community, Carol's 1987 landmark NMBGMR publication on caves of the Guadalupe Mountains<sup>2</sup> remains a widely cited classic almost twenty years after its appearance. It is a foundation document that incited much debate and stimulated others to work in the area. She has also played a critical role in the development of the concept of sulfuric acid speleogenesis, of which the Guadalupe Mountain caves are a world class example (e.g. Hill, 1990)<sup>3</sup>.

Carol Hill is well known and highly respected in the international scientific community. Speleologists and mineralogists worldwide owe her a debt for a series of ground-breaking books beginning in 1976 with the publication of "Cave Minerals". Ten years later, in collaboration with Italian cave mineralogist Paolo Forti, Carol produced "Cave Minerals of the World", the first comprehensive volume on this fascinating branch of mineralogy, followed ten years later by a second edition<sup>4</sup>. Probably the vast majority of speleologists in the world have at least one and probably all three of these volumes on their shelves.

A particularly admirable hallmark of Carol's scientific career has been her outreach into the broader scientific community. She has published in a wide variety of journals and her works are used and cited far beyond the community of cave scientists. She has been a leader in increasing the visibility, quality, and prestige of cave science in the southwestern United States and beyond.

Besides Carol's work in Carlsbad Caverns National Park, New

Mexico and Guadalupe Mountains National Park, Texas, she has conducted research in Kartchner Caverns State Park and Wupatki National Monument, Arizona, Mammoth Cave National Park, Kentucky, Big Bend National Park, Texas, Jewel Cave National Park,

South Dakota, the Waste Isolation Pilot Plant (WIPP) site, New Mexico, and Yucca Mountain, Nevada. Since 1998, her primary research has focused on northern Arizona, where she is using cave and karst science to help unravel the complex history of the Grand Canyon.



Carol climbing up to Falls Cave in the Grand Canyon

Over the years, Carol has been a teacher, mentor and gentle critic to many of her colleagues. She is passionate about her work, but always willing to listen to divergent ideas and opinions. She may not agree with your position, but she always encourages you to pursue your ideas. She has the remarkable ability to draw the best out of her colleagues, thereby increasing the scope and value of both her own work and theirs. Carol has accomplished all of this while raising a family of two children and helping Alan run

his business in laser research and development! Now grandparents of three, Carol and Alan still reside in Albuquerque, New Mexico. She remains an active adjunct faculty member of the Earth and Planetary Sciences Department at the University of New Mexico.

On behalf of the speleological, mineralogical, and geological communities, we thank Carol for her thirty-five years of sustained and high quality effort to advance the science of this region and its unique international treasures.

<sup>1</sup> Hill, C. A., 1996, *Geology of the Delaware Basin, Guadalupe, Apache, and Glass Mountains, New Mexico and West Texas: Permian Basin Section-SEPM Publication No. 96-39*, 480 pp.

Hill, C. A., 1987, *Geology of Carlsbad Cavern and other caves of the Guadalupe Mountains, New Mexico and Texas: New Mexico Bureau of Mines and Mineral Resources, Bulletin 117*, 150 pp.

<sup>3</sup> Hill, C. A., 1990, *Sulfuric acid speleogenesis of Carlsbad Cavern and its relationship to hydrocarbons, Delaware Basin, New Mexico and Texas: American Association of Petroleum Geologists Bulletin*, v.74, p. 1685-1694.

Hill, C.A., and Forti, P. 1997. *Cave Minerals of the World*. Nat. Speleo. Soc. 463 pp.

## PRESIDENT'S MESSAGE

Welcome to southeastern New Mexico and the 57<sup>th</sup> annual Fall Field Conference of the New Mexico Geological Society. This year's conference marks our third venture into the Carlsbad area. Our hosts will share with us a number of wide-ranging geologically and environmentally relevant topics as we explore the subterranean environments of caves; the oil, natural gas, and mineral resources of the area; and the engineering hazards of karst terrain. The hosts for this year's conference are Lewis Land (New Mexico Bureau of Geology and Mineral Resources), Penny Boston (New Mexico Tech), and Bill Raatz (Oxy Permian). Each of these individuals served as editors of the guidebook, along with David Love (New Mexico Bureau of Geology and Mineral Resources) and Kate Ziegler (University of New Mexico). Virgil Lueth once again served as the guidebook's Managing Editor. I recognize all of your countless hours of hard work and thank you for bringing us a professional, high quality publication.

Throughout the conference, attendees will be exposed to the area's regional stratigraphy and features associated with sulfuric acid speleogenesis and cave formation. On the first day, each participant will have a chance to tour at least one of the diverse and magnificent limestone caves of the Guadalupe Mountains – including the world famous Carlsbad Caverns National Park. On the second day, the group will visit Parks Ranch Cave – the second longest gypsum cave in the United States. On the last day, the hosts will share with us hydrology and environmental hazards associated with gypsum karst.

I would like to take this opportunity to thank the many individuals who have contributed to the Society's ongoing success throughout 2006, including Peter Fawcett, Spencer Lucas, Bill McIntosh, Bob Myers, Adam Read, Maureen Wilks, and Tom Williamson. I thank the Spring Meeting Chairs Matthew Heizler and Stacy Timmons for bringing us an informative meeting. I also thank the Board of the Foundation, headed by Paul Catacosinos, for its continued support of scholarships, fellowships, and research grants to both graduate and undergraduate students in New Mexico. The Society acknowledges the continuing support of the New Mexico Bureau of Geology and Mineral Resources. In particular, I thank Peter Scholle, the Bureau's Director, for his support of Society functions and Lynn Hemenway for her support of daily operations.

Like my predecessors, I remain impressed by the participation and commitment of New Mexico geologists to maintaining the quality of our field trips and the distinction of the New Mexico Geological Society. The Society's favorable financial condition and solid reputation are the result of more than 50 years of member participation and contributions. I encourage each and every one of you to volunteer your time and talent to the Society and continue our legacy of being one of the premier geological societies in the nation.

I thank our hosts for their preparation, organization, and coordination of this year's Fall Field Conference. I sincerely hope that you enjoy the fascinating geology, economic wealth, and scenic treasures of southeastern New Mexico's Caves and Karst region.

*Jennifer Lindline*

## CONFERENCE ORGANIZERS' MESSAGE

Welcome to southeastern New Mexico, the Guadalupe Mountains, and the lower Pecos Valley. The spectacular and remote geology of the Guadalupe Mountains region has been visited only twice by the New Mexico Geological Society, first in 1954, and more recently in 1993. This area of the state is of immense economic and scientific importance due to its prolific oil and gas production and its designation by the International Union of Geological Sciences as a Global Stratotype Section for rocks of middle Permian age. Outcrops in the Guadalupe Mountains provide one of the world's finest exposed examples of a rimmed carbonate platform margin, as represented by the Capitan Reef and its associated foreereef talus, deep basin, and backreef facies. Some fundamental concepts of the Permian stratigraphy of North America were originally developed in this area by workers such as George Shumard, G. H. Girty, and G. B. Richardson, as documented by Barry Kues in his Guidebook paper on early geological investigations in the Guadalupe Mountains. Building on this foundation, detailed paleontologic, stratigraphic, sedimentologic, and mapping studies were conducted throughout the mid-twentieth century by such preeminent geoscientists as Phillip B. King, Norman Newell, Phil Hayes, Ward Motts, George Bachman, Vincent Kelley, and Lloyd Pray. These studies helped lay the foundation for the new discipline of carbonate sedimentology.

The Guadalupe Mountains region is also famous for its world-class limestone caves. Two of the largest and deepest known cave systems in North America – Carlsbad Cavern and Lechuguilla Cave – as well as hundreds of other caves, are developed in Permian strata of the Guadalupe Mountains. For this reason, "Caves and karst of southeastern New Mexico" has been chosen as the specific theme for this year's Conference. Beginning in the 1970s, a new paradigm of speleogenesis for caves in the Guadalupe Mountains began to evolve, based on the premise that the large rooms in these caves were of hypogenic origin and had been excavated by ascending waters charged with sulfuric acid, derived from hydrocarbon deposits in the Delaware Basin. The development of this model through the last three decades of the twentieth century was a collaborative effort that included the work of many well known cavers and cave scientists, including Stephen Egemeier, David Jagnow, Kim Cunningham, Michael Queen, Harvey DuChene, Donald Davis, Art Palmer, and Carol Hill, to whom this year's guidebook is dedicated. In the last fifteen years, there has been increasing scrutiny of the role of microbial processes in cave development, by geoscientists and microbiologists such as Diana Northup, Penelope Boston, Mike Spilde and others. Several of these workers have contributed papers to this year's Conference Guidebook.

In addition to the well-known limestone caves of the Guadalupe Mountains, the Carlsbad region also provides outstanding exposures of gypsum karst developed in the Castile and Seven Rivers Formations. These features include Parks Ranch Cave, the second-longest gypsum cave in the United States. The role of gypsum karst in the hydrology of the lower Pecos Valley will be a second recurring theme of this year's Conference.

On the first day of the Conference, we will divide into four smaller groups. All four trips on Day One will provide opportunities to examine the results of sulfuric acid speleogenesis, as manifest in some of the finest examples of limestone caves in the southwest. These trips are organized according to degree of difficulty, ranging from the Carlsbad Cavern tour, which will be conducted entirely on paved trails with artificial lighting and an elevator ride back to the surface; to the McKittrick Hill caves, which are undeveloped and will require more physical agility to visit. The second day of the conference will focus on regional geology of the Delaware Basin, and more specifically on gypsum karst of the Castile Formation, culminating in a visit to Chosa Draw and Parks Ranch Cave. The Chosa Draw area contains some of the best exposed examples of epigenetic gypsum karst development on the Gypsum Plain, including epikarst, sinkholes, resurgent springs, skylights, and cavernous porosity. Day Three will emphasize karst hydrology and engineering problems associated with the Seven Rivers gypsum, and will culminate in a visit to the spectacular gypsum cenotes at Bottomless Lakes State Park, east of Roswell.

This year's Guidebook also includes the first detailed report, by Donald Davis, on the 2001 discovery of the Snowy River pool deposit in Fort Stanton Cave, in the Sacramento Mountains. It has been suggested that the Snowy River deposit, at almost three surveyed km and still going, may be one of the world's longest cave formations. Because of the distance involved, a trip to Fort Stanton Cave is not practical, but a supplemental road log across the Pecos Slope and northern Sacramento Mountains to Fort Stanton Cave has been provided.

The organizing committee would like to extend their thanks to all those who provided assistance with the Conference this year, including Maureen Wilks, Lynne Hemenway, Dana Ulmer-Scholle, Adam Read, Mark Mansell, Lewis Gillard, Dave McCraw, Leo Gabbaldon and many others. We wish particularly to acknowledge the road logging assistance provided by Dave Love and logistical support of Kate Zeigler. This year's Conference would not have been possible without the support of the New Mexico Bureau of Geology and Mineral Resources and the Bureau's Director, Peter Scholle. Finally, we would like to acknowledge the outstanding work of our (always smiling) managing editor, Virgil Lueth.

*Lewis Land  
Penelope Boston  
Bill Raatz*

## **FIELD CONFERENCE SCHEDULE**

### **Wednesday, September 27, 2006 – Pre-conference field trips and registration**

(Field trippers should bring their own lunches)

6:15am	Tour of the Waste Isolation Pilot Plant (WIPP)
7:00am	Tour of Intrepid potash mine
8:00am	Tour of Mosaic potash mine
7:00am	McKittrick Canyon Permian Reef geology trail
1:00pm	Tour of Nash Draw
6:00-9:00pm	Registration and ice-breaker party at Washington Ranch.

### **Thursday, September 28, 2006 – First Day: Limestone caves of the Guadalupe Mountains: Carlsbad Cavern, Slaughter Canyon Cave, Cottonwood Cave, and McKittrick Hill Caves**

6:00-7:15am	Breakfast (provided)
6:00-7:15am	Registration, Washington Ranch.
7:15am	Caravans begin leaving Washington Ranch for field trips (lunch provided)
6:30pm	Barbecue (provided) at Washington Ranch.

### **Friday, September 29, 2006 – Second Day: Regional geology and evaporite karst of the Castile Formation; Parks Ranch Cave**

6:00-7:15am	Breakfast (provided)
7:30am	Caravan departs Washington Ranch (lunch provided at Chosa Draw)
6:00pm	Caravan returns to Washington Ranch.
7:00-9:00pm	Annual banquet (provided). Dr. Art Palmer, keynote speaker.

### **Saturday, September 30, 2006 – Third Day: Hydrology and engineering hazards of gypsum karst, Seven Rivers Formation**

6:00-7:30am	Breakfast (provided)
8:15am	Caravan departs Washington Ranch (lunch provided at Bottomless Lakes)
2:00pm	Conference ends at Bottomless Lakes State Park, east of Roswell.

### **Sunday & Monday, September 31 – October 1, 2006 – Post-conference field trip to challenging caves of the Guadalupe Mountains**