

# 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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*This is a section from the 2003 NMGS Fall Field Conference Guidebook.*

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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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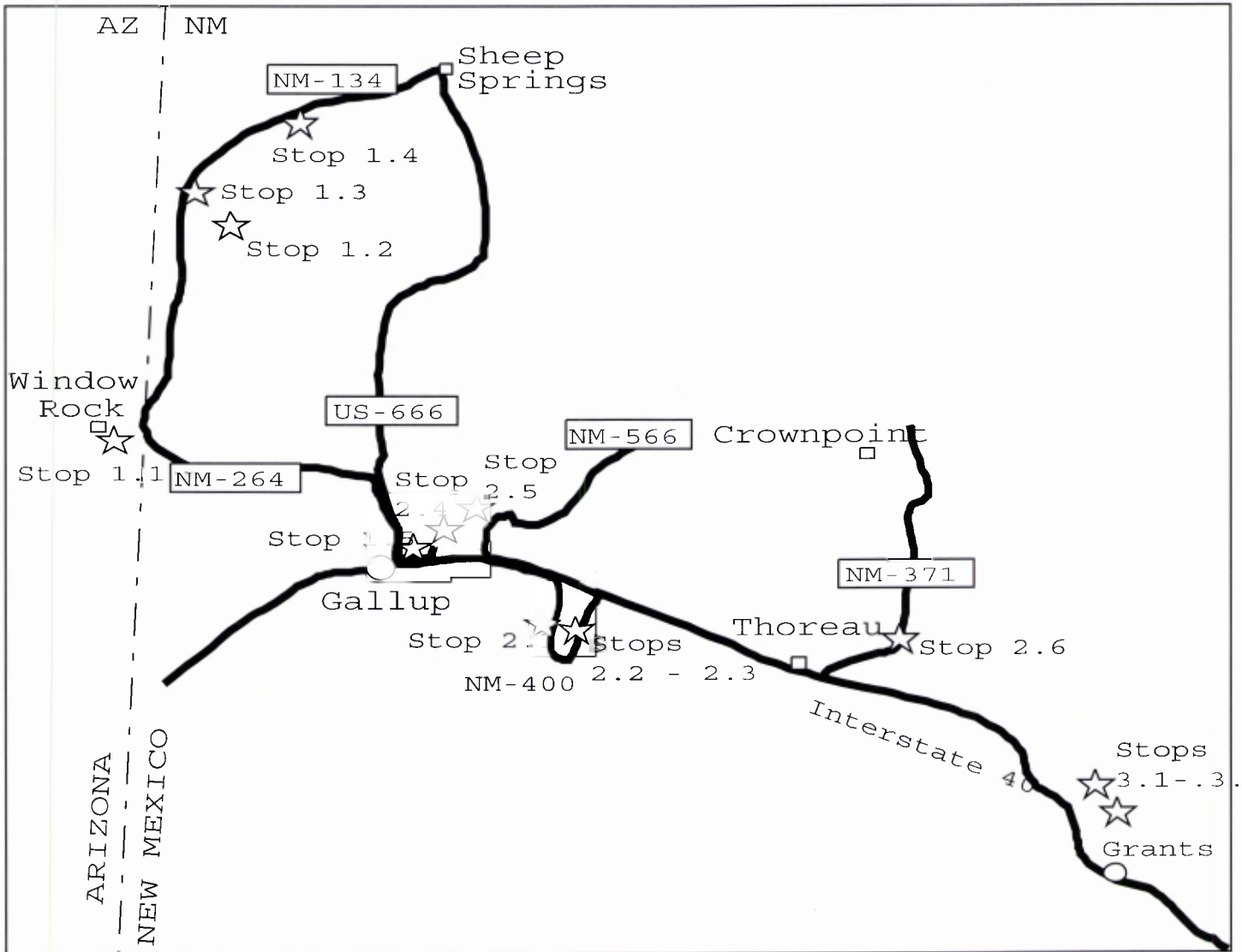
NMGS has decided to make peer-reviewed papers from our Fall Field Conference guidebooks available for free download. This is in keeping with our mission of promoting interest, research, and cooperation regarding geology in New Mexico. However, guidebook sales represent a significant proportion of our operating budget. Therefore, only *research papers* are available for download. *Road logs*, *mini-papers*, and other selected content are available only in print for recent guidebooks.

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# Geology of the Zuni Plateau



## Editors:

Spencer G. Lucas  
Steven C. Semken  
William R. Berglof  
Dana S. Ulmer-Scholle



**New Mexico Geological Society  
Fifty-fourth Annual Field Conference  
September 24-27, 2003**

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## DEDICATION

With great pleasure, I dedicate this book to one of the foremost students of the geology of west-central New Mexico, Orin .1. Anderson. Born in 1938 in Bakersfield, California, the key years of Orin's youth were spent on the family farm in North Dakota. Orin received a bachelor's degree in geology from the University of North Dakota in 1961, and then was employed as a geologist by the U. S. Bureau of Reclamation in Billings, Montana. His work focused on geological investigations of proposed dam and reservoir sites, power transmission corridors and irrigation facilities. Orin soon moved to Minneapolis-St. Paul, where he first spent two years working for Soil Exploration Company, mostly involved in drilling for foundations at proposed construction sites. He then worked for Litton Industries as a soil mineralogist and microbiologist. Further employment followed at the Limnological Research Center of the University of Minnesota, working on lake sediments and water geochemistry.

In 1970, Orin returned to school at the University of New Mexico, where he completed a masters degree in geology in 1973 (thesis topic: "Geology of the Seistan basin, southwestern Afghanistan"). He then took a position as a staff geologist in the Office of the State Geologist in Santa Fe, New Mexico. Here, Orin worked as an economic geologist focused on coal and uranium resources. In 1979, Orin moved to Socorro to the New Mexico Bureau of Mines and Mineral Resources, where he remained for 19 years until his retirement in 1998. Orin began work at the Bureau as a coal geologist, primarily evaluating coal resources and mapping coal-bearing strata in west-central New Mexico. He advanced to the position of Senior Geologist, and



Orin Anderson measuring a stratigraphic section in the Morrison Formation at Placitas, New Mexico in 2000.

from 1989 to 1995, devoted most of his effort to compiling a new, 1:500,000 scale geologic map of the state of New Mexico.

During his nearly two decades at the Bureau, Orin mapped (mostly singlehanded) the geology of fifteen 7.5-minute quadrangles in west-central New Mexico, from Zuni Salt Lake on the south, to Fort Wingate on the north. He also mapped the geology of the Fence Lake 1:100,000 sheet, and several of the quadrangles he mapped were combined for publication as the Atarque Lake 1:50,000 sheet. When Orin retired, much more mapping in west-central New Mexico was completed or underway.

But, beyond the coal geology and the geologic mapping, Orin Anderson solved major problems of the regional stratigraphy of west-central New Mexico, especially with regard to the Jurassic rocks. In particular, in two articles published in 1983, Orin redefined Dutton's 1885 term Zuni Sandstone and deftly solved a problem of Jurassic regional stratigraphy that had persisted for nearly a century.

I should also point out that Orin did yeoman service to the New Mexico Geological Society over many years. He served on the Society's Executive Committee, especially in publication sales. He co-organized two field conferences, in west-central New Mexico (1989) and in the Four Corners (1997), and he helped with many others. The Society elected him an Honorary Member in 1987.

I began to work with Orin in 1988 on that west-central New Mexico field conference. That conference ended at Dowa Yalannê, the sacred mountain of the Zuni people, and the type section of Dutton's Zuni Sandstone. Something was very wrong with how the U. S. Geological Survey interpreted the Jurassic strata on that sacred mountain, Orin and I realized it, and we set out to re-evaluate the Jurassic section on the southern Colorado Plateau. We spent the next decade working on various problems of Mesozoic (mostly Jurassic) stratigraphy in Utah, Arizona, Colorado, New Mexico and West Texas. What came out of it was a revised Jurassic regional stratigraphy and the new interpretations of Jurassic depositional history and paleogeography that the stratigraphy supports. Orin's firm grasp of basic stratigraphic principles, his willingness to question anything in print, his no nonsense approach to lithostratigraphy and his tirelessness on the outcrop were central to the work. I learned much from Orin, and I learned much about him, particularly the meaning of the phrase "you can tell a Swede, but you can't tell him much."

Orin's contributions to the geology of west-central New Mexico thus stand out as both extensive and incisive. In my mind, he joins that short list of the great students of the geology of west-central New Mexico, which now includes Clarence Dutton, Julyan D. Sears, Charles Maxwell and Orin Anderson.

Spencer G. Lucas

## PRESIDENT'S MESSAGE

Welcome to the 54<sup>th</sup> annual Fall Field Conference of the New Mexico Geological Society. This year's conference marks our eighth venture into neighboring Arizona. The first day will find us in the Navajo Nation heartland, very near the area covered by the 18' fall field conference in 1967. This year, with kind permission from the Navajo Nation, we will travel ground never before visited by the Society through Todilto Park and Narbona Pass. On the second day the conference moves its headquarters from Gallup to Grants, taking in the sights and geology of the red rock country. And, on the last day, among other sights, we will view remains of the once-prosperous Grants uranium belt.

Once again Spencer Lucas steps into the breach and serves the Society as your conference co-chair and guidebook editor along with first-timers Bill Berglof and Steven Semken. The road logs you will be following are also the handiwork of Andy Heckert, Barry Kues, Virginia McLemore, Larry Crumpler, Jayne Aubele, Gretchen Hoffman and Don Owen. Fall field conferences do not happen as effortlessly or as spontaneously as they seem, so please take the time to express your appreciation to these individuals. Dana Ulmer-Scholle is once again the Managing Editor of an entirely digital guidebook. The conversion from the days of pencil and Mylar to those of software and electronic data transfer was not always an easy process. We owe a tremendous thank you to Dana for completing this transformation.

The 2003 NMGS Spring Meeting was dedicated to cave and karst geology and included a keynote address by Louise Hose, Director of the newly opened Cave and Karst Research Institute in Carlsbad. The cave and karst theme contributed to a very successful meeting this Spring, and our thanks go to Bill Raatz (General Chair), Penny Boston (Technical Chair) and Sean Connell (Registration Chair).

While the support of the New Mexico Bureau of Geology and Mineral Resources (Bureau) has been appreciated and recognized in this column before, I don't think the Society as a whole recognizes the extent and value of the Society's relationship with the Bureau. The Bureau provides a central location from which the Society operates. This support includes providing staff to maintain NMGS publication sales, membership and registrations for the Spring and Fall meetings. This relationship is beneficial to both sides in that it promotes the knowledge of geology throughout the State. At Society meetings, the publications and work of the Bureau are promoted and acknowledged. In turn, the Bureau promotes Society publications at meetings where Bureau publications are displayed. The State of New Mexico itself benefits from this relationship because it provides a basis for a robust professional organization, one of the largest, and the best geological society in this country. The NMGS Executive Committee has developed a memorandum of understanding with the Bureau, signed in April of this year, to memorialize this relationship.

Like last year, the Society continues to be financially healthy despite the financial market plunge and its affect on our scholarship fund investments. The CPA firm of Beckham and Penner, P.C., now manages the accounts of the Society. The assets of the Society, including scholarship fund accounts, publications inventory, our investment in the Bureau's publication storage building, and our checking account, now top \$1 million. It occurs to me that NMGS is no longer your father's professional society. Managing a million-dollar corporation requires careful and thoughtful planning. The total assets of the Society (as they always have been) are exposed to certain risks and liabilities. This exposure has become

more meaningful as the value has increased. The non-profit status of NMGS, Inc. is in serious jeopardy due to the growth of the Pipkin scholarship account, and the total value of the assets exceeds the amount of protection provided by any reasonably affordable liability insurance policy. The NMGS Executive Committee is considering a major organizational change to address these concerns and to assure that the Society's scholarship accounts are preserved and protected. As this guidebook goes to print, the Executive Committee is seeking professional legal advice as to the wisdom of forming a NMGS Foundation separate and distinct from NMGS, Inc. The thought is to move the growing scholarship accounts into the Foundation. Within this foundation the scholarship accounts would be protected from the normal liabilities of NMGS, Inc. They would be allowed to grow until they become self-sustaining. At the current rate of growth, we expect that could occur in as little as five years. The plan is for the scholarship accounts to become permanently endowed, assuring scholarship awards and subsidies in perpetuity. Some of our sister societies around the country have been using this process with great success for some time. Quite possibly, by the time you are reading this during the 2003 Fall Field Conference, the NMGS membership will have been part of a decision to take this momentous step. I wish to express appreciation to Brian Brister, NMGS Treasurer this year, acknowledging the work he has done in evaluating the productive capability of the Pipkin oil and gas leases and performing the economic analysis that has led to these conclusions.

This year we plan to award \$39,450 in scholarships, fellowships and research grants to both graduate and undergraduate students in New Mexico—a 40% increase over previous years! The overriding royalty in five oil and gas leases in the San Juan Basin, gifted to the Society by Lucille Pipkin, will allow us once again to award a full-year tuition scholarship to a deserving senior at each of the four New Mexico universities offering geosciences degrees. The Pipkin scholarship fund also provides free NMGS memberships to New Mexico undergraduate students and discounts on our publications. The Society enjoys the enviable position of being able to increase scholarship awards while growing the corpus of the scholarship accounts through operating surpluses, the Pipkin royalties, and investment strategies.

The 2004 Fall Field Conference heads to the Taos region and is being organized by Paul Bauer. The 2005 Fall Field Conference will find us in the San Mateo Mountains. It has been 23 years since I attended my first NMGS Fall Field Conference, missing only two conferences in all that time. Like my predecessors, I remain impressed by the participation and commitment of New Mexico geologists to maintaining the quality of our field trips and our Society. I encourage you not only to become more involved with NMGS, but to consider volunteering to be an officer and member of the Executive Committee as well. Borrowing from the words of our Treasurer, the favorable financial condition and quality of the New Mexico Geological Society has resulted from more than 50 years of member sweat-equity. The Society cannot maintain these achievements without your participation.

This year's conference will provide an opportunity to see and appreciate an area of New Mexico and Arizona which has not been visited by the Society in many years. I hope you enjoy the trip and have a great time.

## EDITOR'S MESSAGE

In the summer of 1884, Clarence Dutton (1841-1912), working for a young U. S. Geological Survey, spent two months in west-central New Mexico doing geological field work to produce a map and report on the geology of what he termed the "Zuni Plateau." This area covered approximately 7700 square miles and extended from the Rio Puerco on the east to the Arizona-New Mexico border on the west, and from Zuni Pueblo on the south to the southern end of the Chuska Mountains on the north. Dutton's report stands as a remarkable classic of New Mexico geology. Its mapping, stratigraphy and volcanology provided a solid basis for all subsequent geologic studies in the region.

Long before Dutton, the lands of the Zuni Plateau sustained the indigenous peoples of the Zuni, Acoma, Laguna, and Dine (Navajo) nations. Landforms, climate, and water resources have always figured prominently in the histories, lifeways, arts and ceremonial knowledge of the Native Americans of this region. With respect and care, we will be traversing lands and viewing places many still consider to be sacred.

After Dutton, in the early twentieth century, Cretaceous coal in the Zuni Plateau brought a population explosion to the region and formed the backbone of a bustling economy in Gallup and nearby mining towns. Another U. S. Geological Survey geologist, Julian Sears (1891-1970), came to study the coal geology and with his colleagues provided the first true understanding of transgressive-regressive deposition and stratigraphy of the Cretaceous Western Interior seaway.

After the Second World War, a second mining surge occurred with the fabled discovery of uranium ore that turned Grants into a boom town. From the 1950s until the 1980s, what came to be called the Grants uranium region was the nation's most important source of uranium. Yet another perceptive U. S. Geological Survey geologist, Charles Maxwell (1923-2000) then appeared, and mapped a significant portion of the Zuni Plateau, thereby greatly improving understanding of the regional stratigraphy and volcanics.

The mining in the Zuni Plateau was of uranium and limestone products from the Jurassic strata and of coal from the Cretaceous section. This mining is a major focus of this field conference. The rocks that hosted the mines are a classic section of Mesozoic sediments exposed near the southern border of the Colorado Plateau. They, too, receive much attention in this field conference.

Additional mining, for fluorite, copper, silver, and gold, was in the Zuni Mountains just beyond the field conference route. Finally, long after the Mesozoic, two great volcanic fields pushed through and covered parts of the Zuni Plateau and surrounding regions—the Oligocene-Miocene Navajo volcanic field and the Pleistocene-Holocene Zuni-Bandera-El Malpais field. The intrusives and eruptives of both fields are also well examined by this field conference and by supplemental road log 1. The volcano Mount Taylor is visible during much of the second and third days of the field conference. Supplemental road log 2 covers part of the Pliocene Mount Taylor volcanic field, and reviews pumice and perlite mining. Thus, the conference and the guidebook pursue three major topics: Mesozoic strata, mining, and Cenozoic volcanics.

This is the fourth time that a field conference of the New Mexico Geological Society has visited at least part of the Zuni Plateau. However, the previous trips (in 1951, 1967 and 1989) followed routes that are different from those of this year's conference. In 2003, the conference is headquartered in Gallup and then moves to Grants. The road log routes cross the Chuska and Zuni Mountains and end in the Grants uranium belt. Members of the roadlogging committee worked with us to produce what we believe are detailed and instructive road logs of the conference routes. They deserve special thanks: Jayne Aubele, Larry Crumpler, Andrew Heckert, Gretchen Hoffman, Barry Kues, Virginia McLemore, and Don Owen. Dana Ulmer-Scholle's skill and good cheer as managing editor made this book possible. The Navajo Nation Minerals Department generously granted permission to conduct field studies on Navajo lands on the first day's trip. And, we also thank the following organizations and people for diverse support of the field conference and guidebook: New Mexico Museum of Natural History, U. S. Forest Service, New Mexico Bureau of Geology and Mineral Resources, WERC, a consortium for environmental education and technology development and Dine College.

Spencer G. Lucas  
Steven C. Semken  
William R. Berglof

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William R. Berglof .....	University of Maryland University College
Steven C. Semken .....	Dine College
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### GUIDEBOOK

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### ROAD LOGS

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## FIELD CONFERENCE SCHEDULE AND CREDITS

### Wednesday, September 24, 2003 – Pre-meeting Trip and Registration Day

1:00 PM                      Pre-meeting Trip, El Malpais near Grants  
 6:00 – 9:00 PM              Registration and ice-breaker party, Best Western Inn and Suites, Gallup

### Thursday, September 25, 2003 – First Day, round trip from Gallup to Narbona Pass and return

6:00 – 7:15 AM              Breakfast (not provided)  
 7:00 – 7:30 AM              Registration, Best Western Inn and Suites, Gallup  
 7:30 AM                      Buses leave Best Western Inn and Suites  
 6:00 PM 8:00              Barbeque (provided), Red Rock State Park  
 PM                              Return to Gallup

### Friday, September 26, 2003 – Second Day, Gallup to Grants

6:00 – 7:15 AM              Breakfast (not provided)  
 7:00 – 7:30 AM              Registration, Best Western Inn and Suites  
 8:00 AM                      Caravan leaves Best Western Inn and Suites, Gallup  
 6:00 PM                      Caravan arrives at Best Western Inn and Suites, Grants  
 6:00 – 7:00 PM              Optional visit to Grants Mining Museum (emphasis on uranium mining)  
 6:00 – 7:00 PM              Social hour, La Ventana Restaurant, Grants  
 7:00 PM                      Annual Banquet (provided), La Ventana Restaurant, Grants

### Saturday, September 27, 2003 – Third Day, Grants to Haystack Mountain

6:00 – 7:30 AM              Breakfast (not provided)  
 8:00 AM                      Caravan leaves Best Western Inn and Suites, Grants  
 1:00 PM                      Field Conference ends at Haystack Mountain west of Grants

## CREDITS

**Front Cover:** Photograph of Church Rock by Andrew Heckert

**Inside Front Cover:** Aerial photograph of field conference area by Mark Mansell, New Mexico  
 Bureau of Geology and Mineral Resources

**Title page:** Geologic map of the Zuni Plateau by Clarence Dutton (1885)

**Inside Back Cover:** Stratigraphic chart of field conference area by Spencer G. Lucas

**Logistical Assistance:** Jim Barker and Gretchen Hoffman, New Mexico Bureau of Geology and Mineral  
 Resources, New Mexico Museum of Natural History and Science

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