

# New Mexico Geological Society

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## ***Front Matter***

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

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*This is a section from the 2004 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.

### **Free Downloads**

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 TAOS REGION

## Editors

Brian S. Brister

Paul W. Bauer

Adam S. Read

Virgil W. Lueth



New Mexico Geological Society  
Fifty-fifth Annual Field Conference  
September 22-25, 2004

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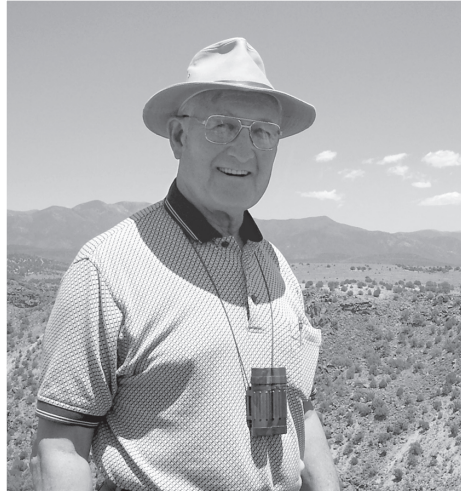
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## DEDICATION

**WILLIAM R. MUEHLBERGER**

Although Bill Muehlberger has never confined himself to one state, one country, one continent, or one celestial body, New Mexico has seen his Brobdingnagian boot-prints from the 1940s to the present. The fascination began when he was an irreverent undergraduate field assistant (to Dick Jahns) in the Ojo Caliente pegmatite district and a teaching assistant (for Lloyd Pray) at the California Institute of Technology field camp in the Sacramento Mountains. Since then, he has mapped and conducted research in the Hillsboro lead-silver district, the Chama region, the Clayton-Raton volcanic field, the Tusas and Picuris Mountains, the Taos Plateau, and the southern San Luis Basin. Results of those efforts have appeared in NMGS and NMBGMR publications, including this volume. Three Ph.D. and thirteen M.A. students have worked here under his supervision, braving local insurrections, overturned vehicles, and sundry other character-building experiences.



eight awards and endowed professorships. Continent- and hemisphere-scale projects reflect the scope of his thinking – he directed production of the first Basement Rock Map of the United States (USGS, 1968) and compiled the most recent Tectonic Map of North America, grounded in plate tectonics concepts (AAPG, 1996).

Beyond the continents and hemispheres of Earth, others of Bill's students have conducted field studies on the Moon. Taos Plateau and the Rio Grande gorge provided excellent geological analogues to features near Apollo mission landing sites. Bill was principal investigator for geology for the Apollo 16 and 17 missions (Muehlberger, 2004, this volume), and since then has con-

tinued to instruct astronauts in Earth observations from Skylab, Apollo-Soyuz, Space Shuttle, and the International Space Station. Two NASA medals attest to his contributions to astronaut and public instruction in geological and solar system exploration: the 1973 Medal for Exceptional Scientific Achievement and the 1999 Public Service Medal.

Space explorers and schoolchildren, teachers and graduate students, retirement home residents and youth groups – legions of us throughout the world can state that Bill Muehlberger has changed the way in which we view our planet.

— Patricia Wood Dickerson



Bill instructs astronauts in field geology at Apollo 15 training site on Rio Grande gorge rim in May 1999.

Construction of his own character included a year studying civil engineering at the University of California at Berkeley, where he also reigned as Intramural Heavyweight Wrestling Champion. His geological schooling (B.S., 1949; M.S., 1949; Ph.D., 1954) was at Caltech, where he achieved distinction in both academic and athletic arenas: outstanding senior of his class, co-developer of the flush seismograph, and fullback of the football team. His collegiate career was punctuated by stints in the Marine Corps (1942-46, 1950-52) and culminated in doctoral work in Sierra Pelona and the Soledad Basin.

He then strode out of southern California, Ph.D. in hand and bolo around his neck, to begin a 50-year affiliation with the University of Texas at Austin – as professor, chairman, and now professor emeritus in the Department of Geological Sciences. His research and that of his 84 graduate students have resulted in hundreds of publications, and his distinguished teaching in



Bill test drives an Apollo exploration backpack and lunar sampling tool in the 1960s.

## PRESIDENT'S MESSAGE

The 55th New Mexico Geological Society Fall Field Conference will be held in the Taos region, previously visited by NMGS in 1966, 1984, and 1990. This year the trip organizer is Paul Bauer, of the New Mexico Bureau of Geology and Mineral Resources. He and many others will be leading us through the Cenozoic geology of the southern San Luis Basin, focusing on volcanic activity, faulting, landscape evolution, and sedimentation. An important aspect of this trip is to highlight discoveries made during recent mapping in the area as part of the STATEMAP project. These include a new understanding of the evolution of the Sangre de Cristo and Embudo fault zones, which we will visit on Day Two.

Guidebook editors Brian Brister, Paul Bauer, Adam Read, and Virgil Lueth have done a superb job with the guidebook articles, and we appreciate their efforts as well as those of the many authors who experienced a somewhat more rigorous round of editing this year. Virgil Lueth, a Past President of NMGS and co-Chair of the 2002 Field Conference, graciously agreed to be the managing editor this year. Virgil has made some improvements to the layout and presentation of the text and images in the guidebook. Each year our guidebooks get better and better. All 55 of them remain in print.

The New Mexico Geological Society has undergone somewhat of a transformation over the past year and I would like to take this opportunity to update you on these changes. Because the non-profit status of NMGS, Inc. was threatened by the growth of some of our investments, the Executive Committee recommended the creation of a separate foundation that would be responsible for the scholarship accounts. At the end of 2003, the NMGS membership voted to create the NMGS Foundation and as of early 2004 all of the NMGS scholarships (such as Grants-in-Aid, Pipkin Undergraduate Research Awards, Pipkin Senior Scholarships, and several others) will be paid from the Foundation Accounts to recipients recommended by NMGS, Inc. committees. The Board of the NMGS Foundation, currently headed by Paul Catacosinos, has four other members including the Vice-President of NMGS, Inc. Brian Brister, Maureen Wilks, and Gary Stephens played an integral role in creating the Foundation and they are thanked for the many hours of their time ensuring that the financial future of the Society is no longer in jeopardy.

I would also like to thank several other people who generally work behind the scenes to make this Society successful. Maureen Wilks, who is currently the Publications Chair, is managing the publication of the new Geologic Highway Map. Adam Read has been the society Webmaster for several years and has

recently updated our website (<http://geoinfo.nmt.edu/nmgs>). Bob Myers has served as the chair of the Scholarship Committee for many years. Theresa Lopez helps with registration at the Spring and Fall Meetings, sells our publications, and in addition to many other duties, is the first point of contact to the outside world. Many thanks to all of you and to any others I may have overlooked.

The relationship between NMGS and the New Mexico Bureau of Geology and Mineral Resources remains strong. We recently signed a Memorandum of Agreement with the Bureau that formalizes our relationship. We thank Peter Scholle and the Bureau for their continued support.

Once again, the scholarships awards were increased from previous years. The Executive Committee has recommended that over \$37,000 be given for various scholarships this year, an increase of about \$5000 from last year. We continue to offer free membership in the Society and discounts on publications for undergraduate and graduate students at New Mexico universities, and we are pleased with the increase in student participation at both the Fall Field Conferences and the Spring Meeting.

Sean Connell, Peter Fawcett, and John Sigda chaired the Spring Meeting this year. The theme was Landscape Evolution and featured a keynote presentation by Vance Holliday. Many thanks go to all of the volunteers, especially Theresa Lopez who helped with the on-site registration.

After many years of preparation, we look forward to publication this summer of the New Mexico Geological Society Special Volume "The Geology of New Mexico," edited by Greg Mack, Kate Giles, and George Austin. This will be the definitive text on our current understanding of the geologic evolution of New Mexico. Soon to follow will be the publication of the completely updated New Mexico Geologic Highway Map.

The 2005 Fall Field Conference will be held in the Chama/Ghost Ranch area, and 2006 will be based in Carlsbad. 2007 will mark a return to the Jemez Mountains and in 2008 we will visit the Gila Wilderness area. As always, we encourage participation from our membership in any capacity, whether writing guidebook articles or road logs, leading field trips, running meetings, contributing ideas for improvements to the Society, or serving on the Executive Committee of either NMGS, Inc. or the NMGS Foundation. On a personal note, I appreciate all of the efforts by those who were involved this past year and especially those who have contributed to help make this year's conference successful.

*Jeffrey M. Amato*

## EDITORS' MESSAGE

We return to Taos after a 20-year hiatus. On the 1984 field conference, participants circumnavigated the Picuris Mountains on Day 1, explored high into the Sangre de Cristo Mountains on Day 2, and crossed the rift into the Tusas Mountains on Day 3. This year, the focus of the conference is quite different. We spend all of the first two days investigating the southern San Luis rift basin. On Day 1 (6 stops, 107 miles), we trace the dramatic Rio Grande gorge, stopping periodically to delve into the geologic history of the sedimentary and volcanic materials that fill the rift and the geomorphic history of the Rio Grande and its tributaries. On Day 2 (5 stops, 49 miles), we plot a course along the southeast boundary of the basin, tracking the structurally complex transition from the master rift fault zone to the rift accommodation zone. On Day 3 (3 stops, 23 miles), we cross from the San Luis to Española Basins, stalking elusive pre-rift structural basins and their spectacular sedimentary sequences.

The roadlogs and papers in this guidebook and the field conference presentations highlight a vast body of new geologic data emerging from the Taos area. The new studies can be roughly divided into three general efforts, although all are connected and somewhat collaborative.

1) Geologic Mapping: Since 1996, the New Mexico Bureau of Geology & Mineral Resources (NMBGMR) STATEMAP program has been producing geologic quadrangle maps of southern Taos County. Six new quads in the Taos area have yielded a tremendous bounty on the geometry of the rift basin, the kinematic and paleoseismic histories of the Sangre de Cristo and Embudo fault zones, the stratigraphy of Pennsylvanian rocks, the significance of the pre-rift Picuris Formation, the hydrogeology of the basin, the Quaternary geomorphic history of the Taos Plateau, and the pre- to post-incision history of the Rio Grande. Several new quads that straddle the transition zone between the San Luis and Española Basins have revealed the geometry and kinematics of the rift accommodation zone, the depositional history of the Santa Fe Group, and the hydrostratigraphy of basin-fill sediments.

2) Geophysics: The second new data set is the high-resolution aeromagnetic survey of the Taos area in 2003. The acquisition of the data represent the best in interagency cooperation; the study was cooperatively planned by scientists from the USGS and NMBGMR, and financed by contributions from the Town of Taos, Taos County, U.S. Bureau of Indian Affairs, Taos Soil & Water Conservation District, U.S. Bureau of Reclamation, and the Office of the State Engineer. The processed aeromag imagery, which is currently being integrated into a subsurface geologic model, is revealing fantastic structural and stratigraphic complexities that are confirming some existing hypotheses and disproving others.

3) Hydrogeology: The third data set is a consequence of work surrounding the availability, quality, and adjudication of water in Taos County. A spate of studies and initiatives have resulted in the creation of some terrific new hydro-

logic resources; the State Engineers Office has developed a hydrologic model that is based on our latest understanding of the stratigraphy and structural geology, the Soil & Water Conservation District has assembled a massive database of Taos County water wells, the U.S. Bureau of Reclamation funded the drilling and hydrogeologic analysis of six deep wells in the Taos area, the county has instigated a Taos County Regional Water Plan, and private consultants have compiled a vast amount of hydrologic data.

You will notice that few of the guidebook papers are reviews of older, established geologic themes. Instead, this guidebook is filled with papers that present new data and interpretations for the first time in print. Similarly, the roadloggers have loaded the logs with fresh information and provocative ideas. You will also note that we have instituted a makeover of the traditional NMGS guidebook format. A 16-page color signature has allowed us to incorporate a variety of new images, maps, and cross sections. The roadlogs now clearly demark each stop and each individual topic of discussion at each stop is summarized in a distinct sub-section. We have also established gray-shaded sidebars that summarize topics of special interest that are encountered outside of the stops. Minipapers have been set into the logs as separate, full-page documents complete with reference lists. We also took advantage of GIS software to generate figures that place geologic data into a spatial framework, often using a shaded relief base rather than a topographic contour base. Waypoint coordinates of stops and major intersections are included for those of you that like to navigate with GPS units. Finally, nearly every stop is accompanied by a digital panoramic image or orthophotographic index map. We hope that these upgrades enhance your guidebook experience.

We earnestly thank all of the following for their contributions to this volume and to the field conference. Brigitte Felix Kludt devoted her artistic talents to improving hundreds of the figures in this book and designed the picturesque cover. Elise Colvin (Bsc, PE, CSM) provided original artwork for open space within the guidebook. Dave McCraw ably assisted with the production of copious color and black & white figures. Sandi Azevedo and Kathy Glesener cheerfully endured drafting of the monstrously detailed, page-sized, black & white geologic maps found in the roadlogs. Mark Mansell stoically worked on GIS tasks for the regional geologic map, and Glen Jones performed other bits of GIS wizardry. We salute all of the authors, reviewers, and roadloggers for their expertise, professionalism, and dedication to furthering the educational and scientific goals of the New Mexico Geological Society. Finally, we acknowledge the New Mexico Bureau of Geology and Mineral Resources and its director Peter Scholle for steadfast support of the production of this guidebook.

*Paul Bauer  
Brian Brister  
Adam Read  
Virgil Lueth*



# NMGS COMMITTEES

## 2004 EXECUTIVE COMMITTEE

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Brian S. Brister, Vice-president .....	New Mexico Bureau of Geology & Mineral Resources
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Lewis Land, Secretary .....	New Mexico Bureau of Geology & Mineral Resources
Gary Stephens, Past President .....	Bureau of Land Management

## FIELD CONFERENCE

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Adam S. Read, Editor .....	New Mexico Bureau of Geology & Mineral Resources
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Barry S. Kues .....	University of New Mexico
Gary A. Smith .....	University of New Mexico
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## PUBLICATIONS COMMITTEE

Maureen Wilks, Chair.....	New Mexico Bureau of Geology & Mineral Resources
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## 2004 FIELD CONFERENCE SCHEDULE

### Wednesday, September 22, 2004---Registration Day

6:00 PM - 9:00 PM    Registration and Icebreaker at Sagebrush Inn, Taos

### Thursday, September 23, 2004---First Day, The Taos Plateau and Rio Grande Gorge

7:00-7:30 AM        Late registration at Sagebrush Inn  
 7:30 AM              Vans depart from Sagebrush Inn  
 6:00 PM              Barbecue at Wolf Creek Ranch  
 8:00 PM              Vans return to Sagebrush Inn

### Friday, September 24, 2004---Second Day, The Flanks of the Rio Grande Rift

7:00-7:30 AM        Late registration at Sagebrush Inn  
 7:30 AM              Vans depart from Sagebrush Inn  
 6:00 PM              Vans return to Sagebrush Inn  
 7:00 PM              Annual Banquet at Sagebrush Inn

### Saturday, September 25, 2004---Third Day, The San Luis Basin to the Española Basin

7:30 AM              Caravan departs from Sagebrush Inn  
 2:00 PM              Field conference ends at Peñasco

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